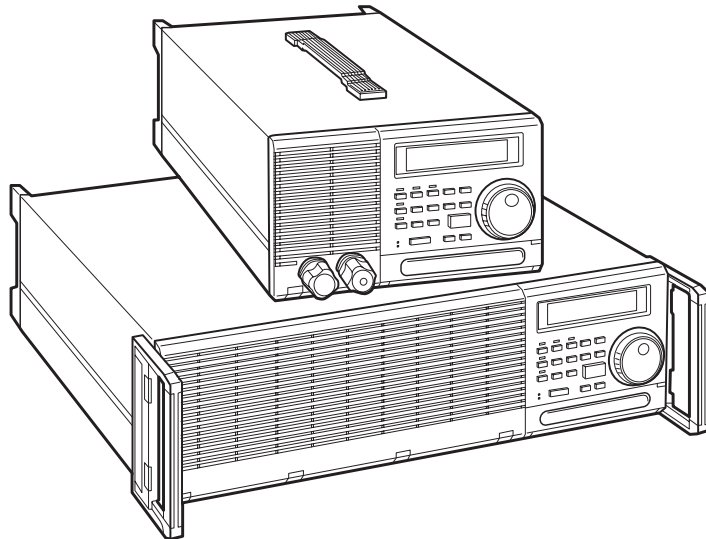


OPERATION MANUAL

ELECTRONIC LOAD
PLZ-3WH SERIES

PLZ 153WH
PLZ 303WH
PLZ 603WH
PLZ1003WH



Use of Operation Manual

Please read through and understand this Operation Manual before operating the product. After reading, always keep the manual nearby so that you may refer to it as needed. When moving the product to another location, be sure to bring the manual as well.

If you find any incorrectly arranged or missing pages in this manual, they will be replaced. If the manual gets lost or soiled, a new copy can be provided for a fee. In either case, please contact Kikusui distributor/agent, and provide the “Kikusui Part No.” given on the cover.

This manual has been prepared with the utmost care; however, if you have any questions, or note any errors or omissions, please contact Kikusui distributor/agent.

Reproduction and reprinting of this product as well as this operation manual, whole or partially, without our permission is prohibited.

Both unit specifications and manual contents are subject to change without notice.

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PLZ-3WH / PLZ-3W Operation Manual Errata

PLZ-3WH: Part No. Z1-002-502, IB003005

PLZ-3W: Part No. Z1-002-492, IB003045

Please make the following changes to the text and figure in this manual.

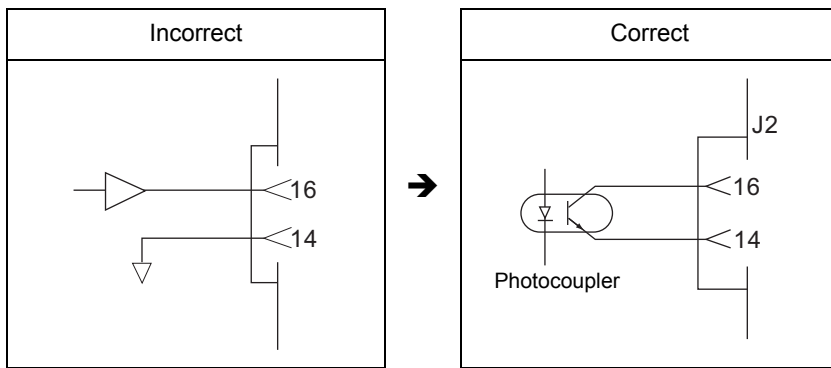
PLZ-3WH: Figure 4.4-10 on page 4-29

PLZ-3W: Figure 3.5-10 on page 3-37

Alarm output terminals are equipped with open-collector-type photocoupler and isolated from other terminals.

The maximum rating of the photocoupler sensor is as follows:

V_{ceo}: 30 V, I_c: 5 mA, P_c: 150 mW



PLZ-3WH / PLZ-3W: Table 7.1-8 on page 7-5

Add the alarm output terminal item to the specifications of the remote control connector.

	PLZ153WH PLZ153W	PLZ303WH PLZ303W	PLZ603WH PLZ603W	PLZ1003WH PLZ1003W	Unit
Alarm output terminal (floating output)	Photocoupler (open collector) Rated voltage: 30 V Rated current: 5 mA				—

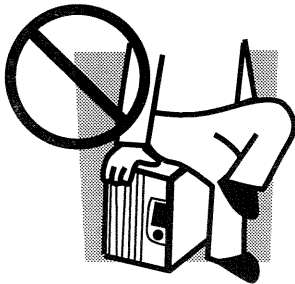
Safety Precautions

The following safety precautions must be observed to avoid fire hazard, electrical shock, accidents, and other failures. Keep them in mind and make sure that all of them are observed properly.



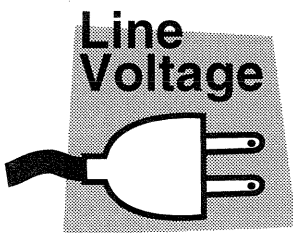
Users

- This product must be used only by qualified personnel who understand the contents of this operation manual.
- If it is handled by disqualified personnel, personal injury may result. Be sure to handle it under supervision of qualified personnel (those who have electrical knowledge.)



Purposes of use

- Do not use the product for purposes other than those described in the operation manual.



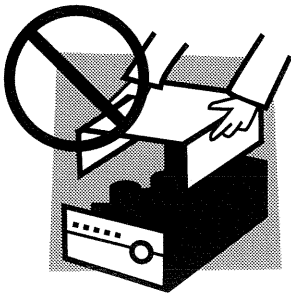
Input power

- Use the product with the specified input power voltage.
- For applying power, use the AC power cord provided. Note that the provided power cord is not use with some products that can switch among different input power voltages or use 100 V and 200 V without switching between them. In such a case, use an appropriate power cord. For details, see the relevant page of this operation manual.



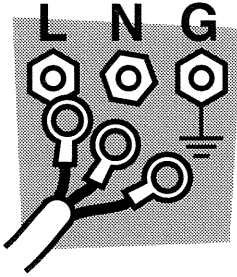
Fuse

- With products with a fuse holder on the exterior surface, the fuse can be replaced with a new one. When replacing a fuse, use the one which has appropriate shape, ratings, and specifications.



Cover

- There are parts inside the product which may cause physical hazards. Do not remove the external cover.



Installation

- When installing products be sure to observe "Precautions for Installation" described in this manual.
- To avoid electrical shock, connect the protective ground terminal to electrical ground (safety ground).
- When applying power to the products from a switchboard, be sure work is performed by a qualified and licensed electrician or is conducted under the direction of such a person.
- When installing products with casters, be sure to lock the casters.



Relocation

- Turn off the power switch and then disconnect all cables when relocating the product.
- Use two or more persons when relocating the product which weights more than 20 kg. The weight of the products can be found on the rear panel of the product and/or in this operation manual.
- Use extra precautions such as using more people when relocating into or out of present locations including inclines or steps. Also handle carefully when relocating tall products as they can fall over easily.
- Be sure the operation manual be included when the product is relocated.

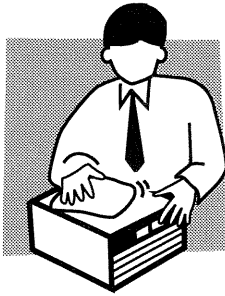


Operations

- Check that the AC input voltage setting and the fuse rating are satisfied and that there is no abnormality on the surface of the AC power cord. Be sure to unplug the AC power cord or stop applying power before checking.
- If any abnormality or failure is detected in the products, stop using it immediately. Unplug the AC power cord or disconnect

the AC power cord from the switchboard. Be careful not to allow the product to be used before it is completely repaired.

- For output wiring or load cables, use connection cables with larger current capacity.
- Do not disassemble or modify the product. If it must be modified, contact Kikusui distributor/agent.



Maintenance and checking

- To avoid electrical shock, be absolutely sure to unplug the AC power cord or stop applying power before performing maintenance or checking.
- Do not remove the cover when performing maintenance or checking.
- To maintain performance and safe operation of the product, it is recommended that periodic maintenance, checking, cleaning, and calibration be performed.

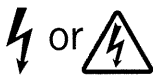






Service

- Internal service is to be done by Kikusui service engineers. If the product must be adjusted or repaired, contact Kikusui distributor/agent.

Safety Symbols

This operation manual and this product use the following safety symbols. Note the meaning of each of the symbols to ensure safe use of the product. (As using symbols depend on the product, all of symbols may not be used.)

	<p>Indicates the presence of 1000V or higher. Never attempt to touch this part when the power switch of the product is turned on.</p>
<p>■ WARNING ■</p>	<p>Indicates the possibility of personal injury or death. Never fail to follow the operating procedure. Do not proceed beyond a WARNING sign until the noted conditions are fully understood and met.</p>
<p>▨ CAUTION ▨</p>	<p>Indicates the existence of damage to the product or connected equipment. Always follow the operating procedure. Do not proceed beyond a CAUTION sign until the indicted conditions are fully understood and met.</p>
<p>□ NOTE □</p>	<p>Indicates additional information such as operating procedure.</p>
<p>— Description —</p>	<p>Describes technical terms used in this manual.</p>
	<p>Indicates action prohibited.</p>
	<p>Indicates general warning, caution, risk of danger. When this mark is indicated on the product, refer the relevant section of the Operation Manual.</p>
	<p>Indicates a grounding (earth) terminal.</p>
	<p>Indicates a chassis grounding terminal.</p>

Configuration of the Operation Manual

This manual consists of the following chapters.

Chapter 1 General

Presents an outline and the features of PLZ-3WH series electronic load units.

Chapter 2 Installation and Preparation

Describes pre-operation procedures such as installation, arrangement of load wires, and operational checks.

Chapter 3 Designations and Basic Functions of Controls

Describes the designations and basic functions of the controls positioned on the front and rear operation panels.

Chapter 4 Operating Procedure

Describes the basic functions and operating procedures of the load unit.

Chapter 5 Remote Control

Describes the operating procedures and programming techniques necessary to remotely control the load unit from an external unit, such as a PC, via an optional interface board.

Chapter 6 Maintenance and Calibration

Describes how to maintain, inspect, and calibrate the load unit.

Chapter 7 Specifications

Lists the electrical features, dimensions and weight, accessories, and options of the load unit.

Appendix

Lists error messages, sequence preparation sheets, functions, and sample programs.

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1

Chapter 1 General

This chapter presents an outline and the features of PLZ-3WH series electronic load units.

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1.1 General

The PLZ-3WH series electronic load unit is a multifunctional system designed to offer the highest levels of safety and reliability. This load unit contains a high-performance current control circuit to ensure stable, high-speed operating performance. In addition, its CPU control feature works to improve operability and multifunctional capability.

The unit's constant power-control feature allows you to, for example, test batteries more efficiently. Moreover, when various optional interfaces or a dedicated remote controller are employed, the load unit can be incorporated into a wide-ranging test and inspection system. This PLZ-3WH load unit also permits various high-speed load simulations to be conducted.

1.2 Feature

The PLZ-3WH series electronic load unit offers a wide array of features. This section describes some of the more notable ones.

■ Constant power mode

The load unit supports a constant power-mode control feature which is highly effective in battery life tests. Constant current, constant resistance, and constant voltage modes are also available.

■ 50 μ s high-speed operation

Constant current mode provides rise and fall times as short as 50 μ s, thereby allowing you to conduct more accurate DC power transient response tests and to generate simulated waveforms for use as dummy loads.

■ Sequence function

With PLZ-3WH units, arbitrarily set sequence patterns can be saved to built-in memory. Two types of sequences are available: a fast speed sequence programmable at 100 μ s a step; and a normal speed sequence allowing ramp waveforms to be set for every step. The saved sequence patterns can be executed using either a host controller or trigger signal from a PC (via an interface), or from the operation panel of the load unit.

■ Operability

Major functions of the load unit can be promptly triggered, due to the unit's "one key - one function" design philosophy. Highly precise settings can be easily input using the jog-shuttle or optional numeric-key unit. The optional remote controller ensures remote control capability. And for repetitive tests, there are two highly convenient functions: a setup function, helpful in saving and calling set items; and a dedicated-key operating function, which allows operating mode settings to be easily saved and retrieved.

■ User-friendly backlit liquid crystal display

Since this load unit is equipped with an LED-backlit liquid crystal display (LCD), operating instructions and test data are easily viewed and monitored regardless of surrounding lighting conditions.

■ Abundant interface boards (optional)

These optional interface boards support various control methods allowing a variety of functional systems to be developed in combination with the unit's sequence functions. When our unique MCB extension serial interface is used, for example, up to fifteen devices (electronic load units and/or power supplies) can be controlled on-line from a single general-purpose interface.

1.3 Operation Manual and ROM Version

This manual applies to products equipped with any of ROM versions 2.00 to 2.09.

When contacting us with a question about one of our products, please provide us with the following information concerning the product:

- Type
- ROM version
- Manufacturing number (indicated on the product rear panel)

For information on how to confirm which ROM version you have, see Section 2.5, "Operational Check" of Chapter 2.

WARNING

If you are not familiar with this type of electronic load unit, or are attempting to reinstall such a unit, be sure to first read the "Safety Precautions" and Chapter 2, "Installation and Preparation," in order to ensure that you conduct all specified work correctly.

2

Chapter 2 Installation and Preparation

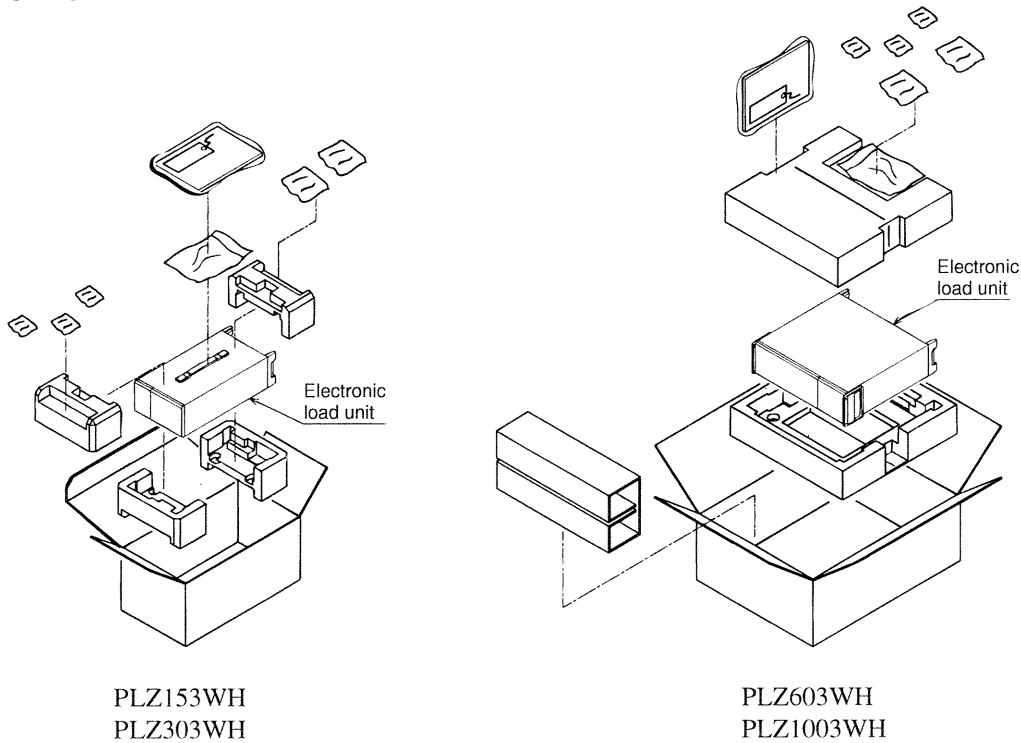
This chapter describes pre-operation procedures such as installation, arrangement of load wires, and operational checks.

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2.1 Unpacking and Checking

Upon receipt of your PLZ-3WH series electronic load unit, check that the product has not been damaged during transportation, and that all specified accessories are present in the package. If any damage or missing parts are noted, contact your Kikusui agent.

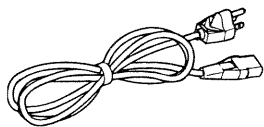
Packing diagram



NOTE

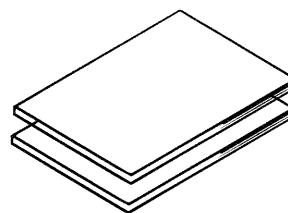
Keep the packing materials, as they will be reused in any subsequent transportation of the unit.

Accessories

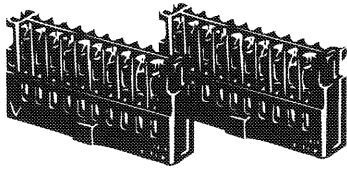


(1) AC power cable (1 ea.)

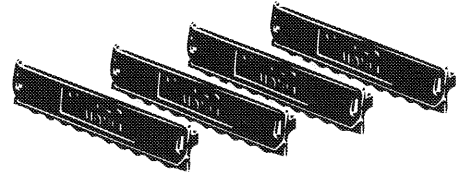
Different types of power cables are provided, depending on the settings of the line voltage range at the time of delivery.



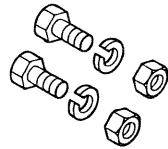
(2) Operation Manual (1 ea.)
Sequence Operation Guide Book (1 ea.)



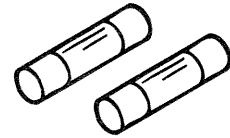
(3) External control plug (2 ea.)



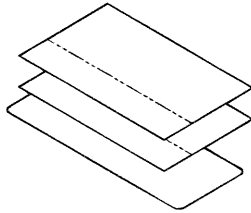
(4) External control plug cover (4 ea.)



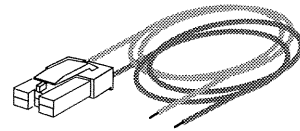
(5) Load terminal connecting bolt, nut, and spring washer (2 ea., respectively)
M6-14 (PLZ153WH and PLZ303WH)
M8-18 (PLZ603WH and PLZ1003WH)



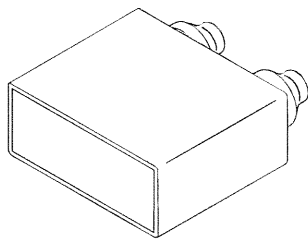
(6) Fuse in different rating (2 ea.)



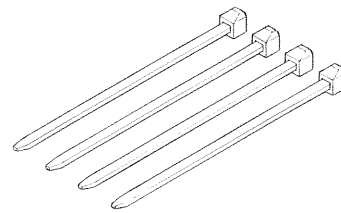
(7) Seal
"Filter cleaning" seal (Japanese) (1 ea.)
"Filter cleaning" seal (English) (1 ea.)
"Caution" seal (1 ea.)



(8) Remote sensing wire kit



(9) Load terminal cover (1 ea.)



(10) Load terminal cover securing binder (4 ea.)

The table below lists fuse ratings.

(Rated voltage: 250 VAC)

	Product for 100 V power system		Product for 200 V power system	
	Fuse in AC inlet 100 V rating	Fuse, 200 V rating	Fuse in AC inlet 200 V rating	Fuse, 100 V rating
PLZ153WH	1.5A (S.B) 1 ea.	1A (T) 2ea.	1A (T) 1 ea.	1.5A (S.B) 2ea.
PLZ303WH	1.5A (S.B) 1 ea.	1A (T) 2ea.	1A (T) 1 ea.	1.5A (S.B) 2ea.
PLZ603WH	2A (S.B) 1 ea.	1.6A (T) 2ea.	1.6A (T) 1 ea.	2A (S.B) 2ea.
PLZ1003WH	3A (S.B) 1 ea.	1.6A (T) 2ea.	1.6A (T) 1 ea.	3A (S.B) 2ea.

2.2 Precautions on Transport

WARNING

Before moving your load unit, be sure to unplug the AC power cable and turn off the power from the switchboard.

To move a PLZ153WH or PLZ303WH unit, grip the handle on its top.

To move a PLZ603WH or PLZ1003WH, pull out the handles from the unit, as shown in the figure at right. Slide the two locks on the handle simultaneously toward "UNLOCK" until you hear a "click" sound. Now, you can use the handle. To return the handle to its normal location, slide the two locks toward "UNLOCK" simultaneously and push the handle until it locks back into place.

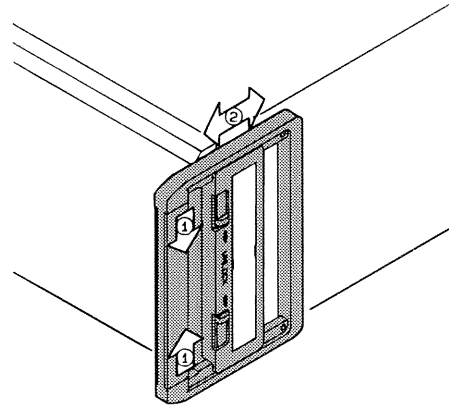


Fig. 2.2-1

Precautions on Transportation

When you want to transport your load unit, be sure to use the packing materials originally provided (and repack it as shown in the original packing diagram). If you need any packing materials, contact your Kikusui agent.

CAUTION

Before packing the load unit, be sure to remove the power and connecting cables.

2.3 Precautions on Installation

This section lists precautions on installation of your PLZ-3WH series electronic load unit. Always observe these instructions.

■ Do not use the load unit in a flammable atmosphere:

Do not use the load unit near flammable materials such as alcohol and thinner, or in an atmosphere filled with evaporated flammable materials. Otherwise, an explosion or fire may occur.

■ Avoid locations exposed to high temperatures or direct sunshine:

Do not install the load unit near windows, heating facilities or equipment, or locations prone to sharp fluctuations in temperature.

Operating temperature range: 0°C to 40°C

Storage temperature range: -20°C to 70°C

■ Avoid highly humid locations:

Do not install the load unit near water lines, water heaters, humidifiers, or showers.

Operating humidity range: 30 to 80 %RH (no condensation permitted)

Storage humidity range: 30 to 80 %RH (no condensation permitted)

■ Do not place the load unit in a corrosive atmosphere:

Avoid using the load unit in an atmosphere where a corrosive gas will be generated or where sulfuric acid mist is present. Such compounds will corrode the unit's internal conductors or cause imperfect contact, causing unit malfunctions and at worst, a fire.

■ Do not install the load unit in dusty locations.

■ Do not use the load unit in imperfectly ventilated locations:

Avoid using the load unit in locations having imperfect ventilation. Ensure at least 30 cm of clearance around the rear panel of the unit. Do not block the air inlet and outlet.

■ Do not install the load unit in tilted or vibration-prone locations.

■ Do not use the load unit in locations exposed to strong magnetic or electric fields.

2.4 Confirmation of AC Input Voltage, Connection of AC Power Cable, and Grounding

2.4.1 Selecting the AC Input Voltage Range and Replacing Fuses

Four AC input voltage ranges are available for the load unit. Check the default settings to determine whether the voltage is suitable for your load unit. Use a fuse appropriate for your line voltage range. Four AC input voltage ranges are shown in the label on the bottom face of the load unit.

WARNING

To prevent electric shock, be sure to unplug the AC power cable or turn the switch on the switchboard off before checking or replacing the fuse.

CAUTION

Make sure that the fuse used conforms to the load unit specifications, including shape, rating, and characteristics. Using a fuse with different rating or short-circuiting, the fuse holder will damage the load unit.

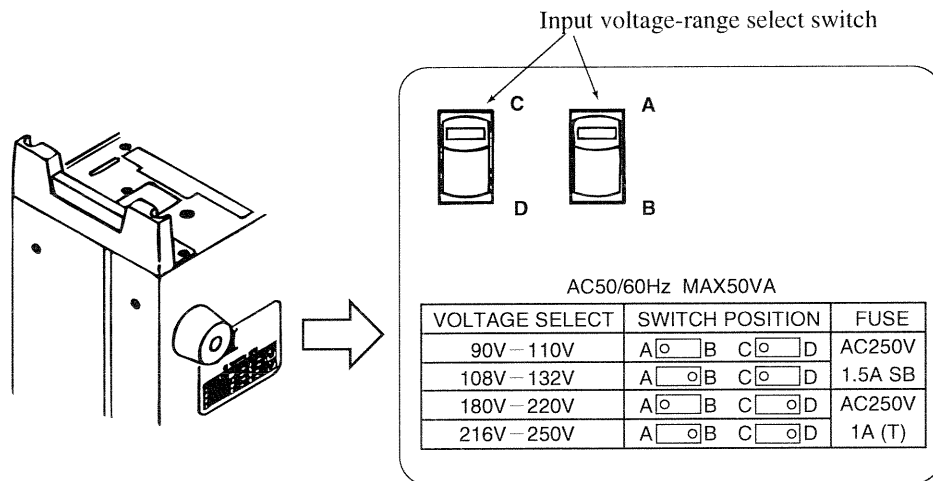


Fig. 2.4-1

When checking or changing the AC Input voltage range, or when checking or replacing the fuse, observe the following instructions:

- (1) Check that the [POWER] switch of the load unit is turned off.
- (2) Unplug the AC power cable from the load unit.
- (3) Check the input voltage-range switch at the bottom of the load unit to determine whether it is set at an appropriate voltage for the load unit.

To change the setting, follow the instructions on the SWITCH POSITION as shown in the label on the bottom.

- (4) Remove the fuse holder cover (Fig. 2.4-2).
- (5) Check the fuse to make sure its rating is within the AC Input voltage range.

If necessary, replace with an appropriate fuse.

- (6) Reset the cover of the fuse holder.

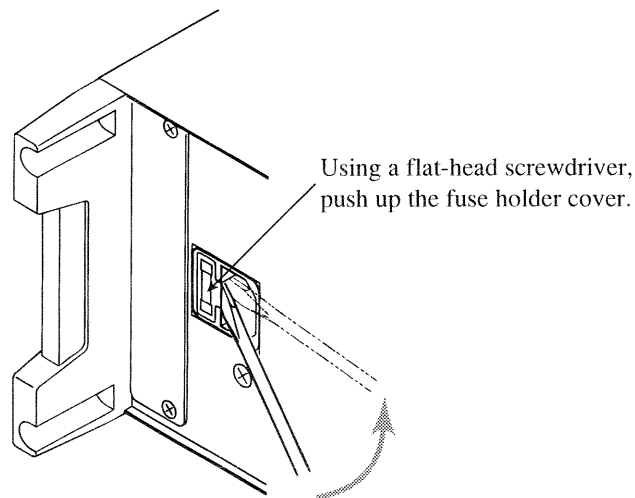


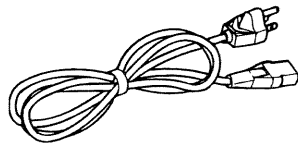
Fig. 2.4-2

2.4.2 Connecting the AC Power Cable

The AC power cable that is provided varies depending on the destination for the product at the factory-shipment.

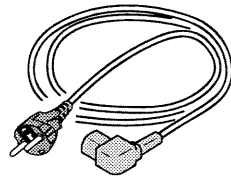
WARNING

The AC power cable for 100 V system shown in Fig. 2.4-3 has a rated voltage of 125 VAC. If this power cable is used at the line voltage of a 200 V system, replace the power cable with that satisfying that line voltage. Appropriate power cable must be selected by qualified personnel (those who have electrical knowledge). If such a power cable cannot be obtained, contact your Kikusui distributor/agent.



Power cable for 100 V system [85-AA-0004]
Rated voltage: 125 VAC
Rated current: 10 A

Fig. 2.4-3 AC power cable for 100 V system



Power cable for 200 V system [85-AA-0005]
Rated voltage: 250 VAC
Rated current: 10 A

Fig. 2.4-4 AC power cable for 200 V system

Do not use the power cable attached to this product for the power cable of other instruments.

Make connections as follows:

- (1) Check that the [POWER] switch of the load unit is turned off.
- (2) Connect the AC power cable to the AC power connector on the rear panel.
Use the provided power cable or power cable that is selected by qualified personnel.
- (3) Plug the power cable into the receptacle.

2.4.3 Grounding

WARNING

- Not grounding the load unit creates danger of electric shock.
- Connect the ground terminal to an electrical ground (safety ground).

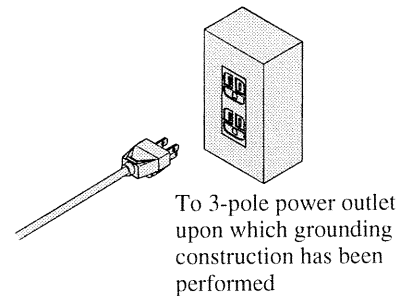
CAUTION

- Not performing adequate grounding work on the load unit results in malfunction or the production of large noises from the load unit.

To ensure safety, provide secure grounding.

The load unit can be grounded by one of the two methods specified below. Select one, and ground the load unit securely.

1. Plug the AC power cable into a 3-pole power outlet upon which grounding construction has been performed.



2. Connect terminal \oplus on the load unit rear panel to the ground terminal (GND).

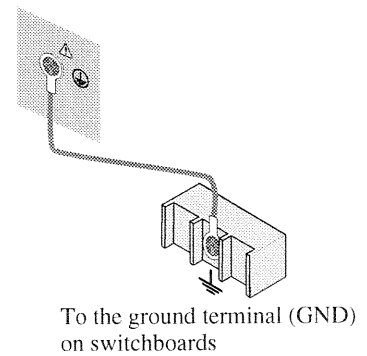


Fig. 2.4-5

2.5 Operational Check

Use the following procedure to check that the PLZ-3WH series electronic load unit works normally.

- (1) Check that the [POWER] switch of the load unit is turned off.
- (2) Check that the AC power cable is connected to the load unit.
- (3) Connect the AC power cable to the AC receptacle. If the AC power cable has been connected to the switchboard, turn it on.

CAUTION

Check that the AC input voltage and frequency fall within their respective rated ranges.

- (4) Turn on the [POWER] switch of the load unit.
- (5) Check the display (see below).

Example of normal indication

PLZ153WH	7.5A	150W
I/F None		

(After about 2 s)

PLZ153WH	7.5A	150W
Ver 1.00		

(The lower field shows the ROM-version information.)

(After about 2 s)

0.000A	0.0V	0.0W
-- ISET 0.000A H --		

Example of faulty indication:

If either of the following events occurs, the load unit may have failed. If you take the action(s) listed below but the faulty condition still remains, contact your Kikusui agent.

(No Message)

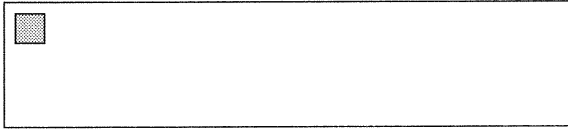
The backlight remains off and no message is observed:

Check the AC power cable connection and turn on the [POWER] switch again.

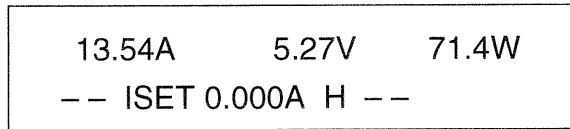
(No Message)

The backlight goes on but no message is observed:

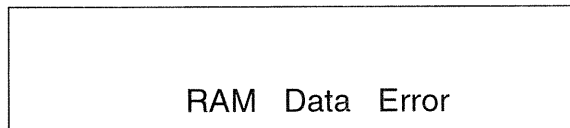
Adjust the contrast (the contrast varies depending on the operating temperature), and turn on the [POWER] switch again.

**Only the cursor is observed:**

If the optional interface board has been used, remove it and turn on the [POWER] switch again, then check the display. If messages appear correctly, turn off the [POWER] switch once and mount the interface board, then turn on the [POWER] switch again.

**An incorrect current or power is observed:**

Turn on the [POWER] switch again.

**An error message is observed:**

Take action suitable for the error in question according to Appendix 1, "Error Messages", then turn on the [POWER] switch again.

- (6) Press the [I SET] key to turn on the lamp above it. Now, you can set the constant current (CC) mode.
- (7) Press the [LOAD] key and check that the lamp above it goes on.
- (8) Press the [LOAD] key again and check that its lamp goes off.
- (9) Turn off the [POWER] switch to complete the checking sequence.

2.6 Arrangement of Load Wires

To ensure that the PLZ-3WH series electronic load unit works accurately and reliably, all wires should be connected to their loads correctly.

In this manual, the terminal that is located on the rear panel and connected to the equipment to be tested is called the "load terminal". On PLZ153WH and PLZ303WH units, load terminals are also positioned on the front panel; these are called "auxiliary load terminals". (See Chapter 3, "Designations and Basic Functions of Controls".)

2.6.1 Precautions on Arrangement of Load Wires

● Electric wire used

If the resistance of load wires is high and a current is supplied, the voltage observed on the load terminal may drop below the minimum operating voltage of 5 V. To avoid this undesirable situation, select thicker-gauge wires where possible.

CAUTION

Use a load wire having sufficient diameter for the current as well as a strong, nonflammable or flame-resistant cover.

The table below lists the size of the load terminal connection bolts.

Table 2.6-1

	PLZ153WH	PLZ303WH	PLZ603WH	PLZ1003WH
Auxiliary load terminal on front panel	M6	M6	—	—
Load terminal on rear panel	M6	M6	M8	M8

● Inductance of load wire

If the load wire is long or has a large loop, inductance is increased. Consequently, current variation will cause a severe voltage drop. When the load terminal voltage drops below the minimum operating voltage of 5 V, the current waveform will be disturbed or a current phase lag will occur, thus causing unstable control and oscillation of the load unit. Especially in cases where short rise and fall times have been selected, this phenomenon can occur with significant frequency.

When the equipment to be connected is inductive, the phase may be rotated to induce oscillation as well. If the equipment is capacitive, such trouble will not occur.

To prevent the troubles explained above, connect the load unit and equipment using short and twisted wires as shown in the figure below.

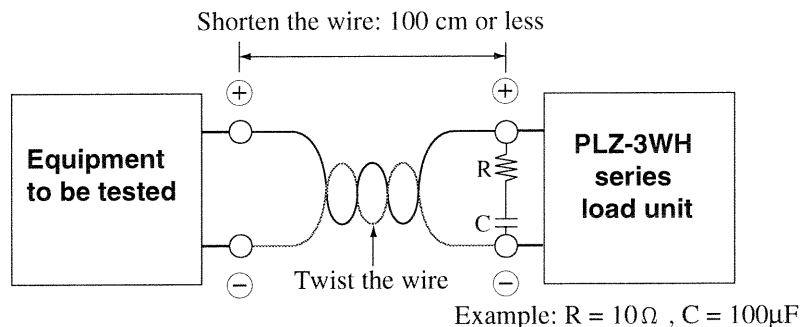


Fig. 2.6-1

NOTE

If only DC-power-related motion is needed, oscillation can be reduced by connecting the capacitor and resistor to the load terminal in series. With this configuration, however, pay careful attention to the capacitor ripple current.

● **Overvoltage**

Up to 500 VDC can be applied to the load terminal. If voltage in excess of 500 VDC is applied, the load unit will be damaged.

CAUTION

Do not apply voltage in excess of 500 VDC to the load terminal. If an overvoltage is applied to the load unit, an alarm message appears, an alarm buzzer sounds, and the load is turned off. If this sequence occurs, immediately reduce the voltage on the equipment being tested.

0.000A	525.0V	0.0W
--	*ALARM* OVER-V	--

● **Polarity**

The polarity of the load terminal should agree with that of the equipment to be tested. If the two units are connected using unmatched polarities, an overcurrent may flow into the load unit and damage it.

CAUTION

If the polarities are not identical, an alarm message appears and an alarm buzzer sounds. Immediately turn off the equipment being tested. (Note: the buzzer sounds when a reverse voltage of at least 0.6 V is applied).

0.00A	0.00V	0.0W
--	*ALARM* REVERSE	--

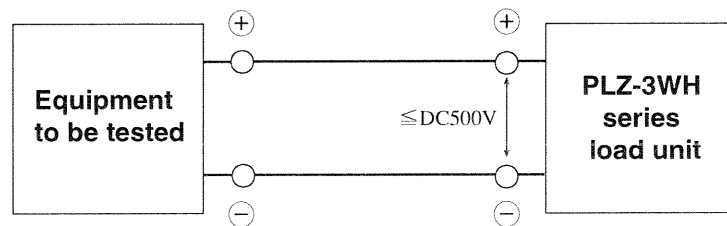


Fig. 2.6-2

2.6.2 Arrangement Procedure of Load Wires

WARNING

- Do not touch an energized load terminal. Pay careful attention to the load terminal, since the voltage output from the connected equipment is applied to this terminal, creating a potential electric shock hazard.
- For PLZ153WH and PLZ303WH load units, do not connect different devices for testing to the front panel auxiliary load terminals and rear panel load terminal simultaneously. Since these front and rear load terminals are connected each other inside the load unit, the voltage input to one terminal is output directly to the other terminal.

- (1) Turn off the [POWER] switch of the load unit.
- (2) Check that the output voltage of the equipment to be tested is 500 VDC or less.

CAUTION

The maximum input voltage of the PLZ-3WH series electronic load unit is 500 VDC.

- (3) Check that the present output voltage of the target equipment is 0 V.
- (4) Attach a crimp terminal to the electric wire as explained above, pass the wire through the load terminal cover, and connect it to the load unit. The illustration below shows how to use the load terminal cover.

CAUTION

Be sure to use the load terminal cover, and to attach a crimp terminal to the wire and connect it to the load unit using the accompanying bolts.

NOTE

For PLZ153WH and PLZ303WH load units, the front panel auxiliary load terminals can be used instead of the rear panel load terminal. However, the auxiliary load terminals may not meet the load unit specifications.

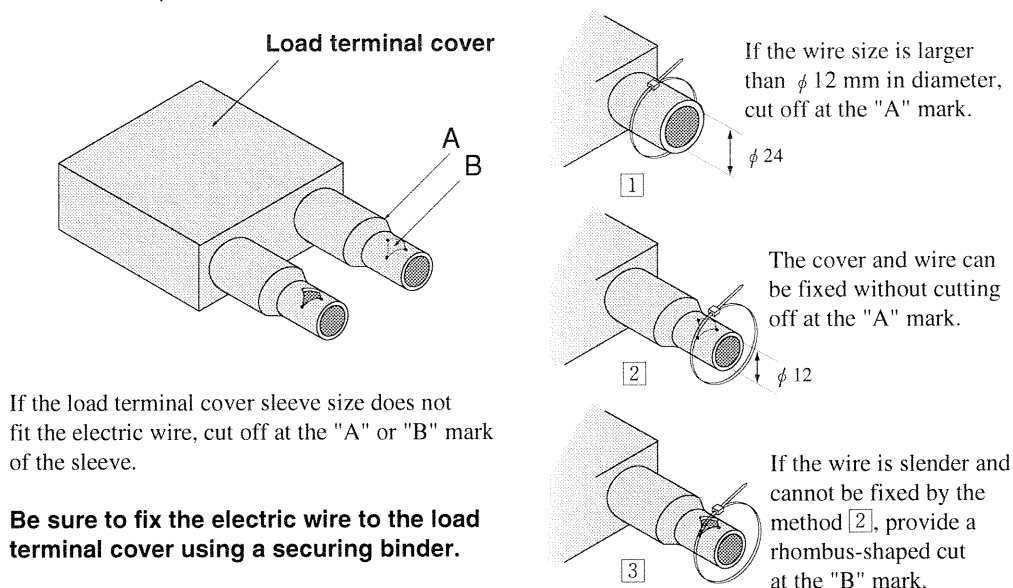


Fig. 2.6-3

2.6.3 Remote Sensing

To compensate for any voltage drop in the load wires and accurately set the resistance, voltage, and power, use remote sensing. We recommend remote sensing, since the transient characteristics of CR and CP modes specifically can be improved and overall operating performance stabilized.

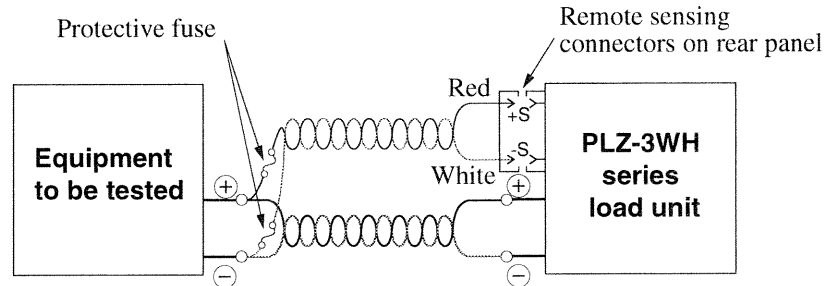


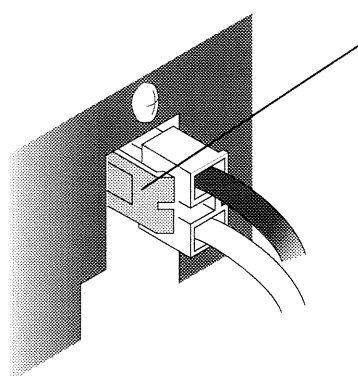
Fig. 2.6-4

Wire Arrangement for Remote Sensing

- (1) Connect the red wire (+S side) and white wire (-S side) of the remote sensing wire kit to the plus (+) and minus (-) terminals of the equipment to be tested, respectively.
- (2) Plug the connectors of the remote sensing wire kit into the remote sensing connectors on the load unit.

CAUTION

- If the load wires are disconnected during remote sensing, the load unit may be damaged. If a protective fuse is connected to each wire, accidents can be avoided (see the figure above). Use the fuse having an amperage of 0.5 A and a rated voltage above the output voltage of the equipment to be tested.
- If remote sensing is not used, disconnect the remote sensing wire kit from the load unit. The illustration below shows how to disconnect the relevant wires.



To unplug a wire, pull the connector toward you while pressing the section shown (while the connector is unlocked).

Be sure to hold the connector and pull it out. If you hold the wire and pull out the connector, the wire may separate from the connector.

Fig. 2.6-5

3

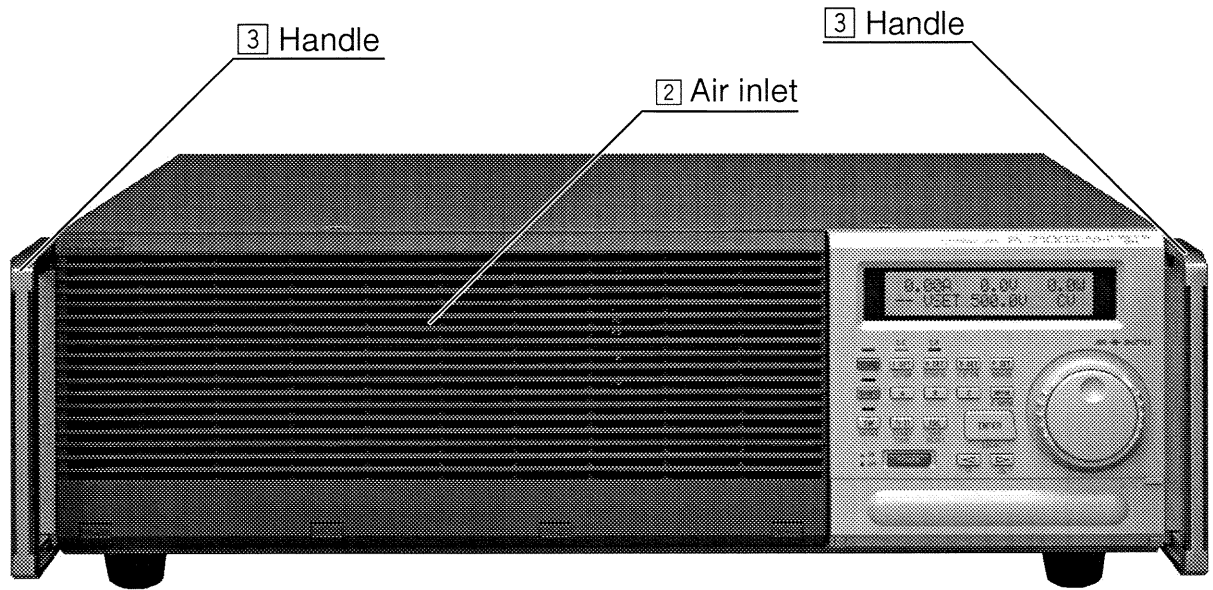
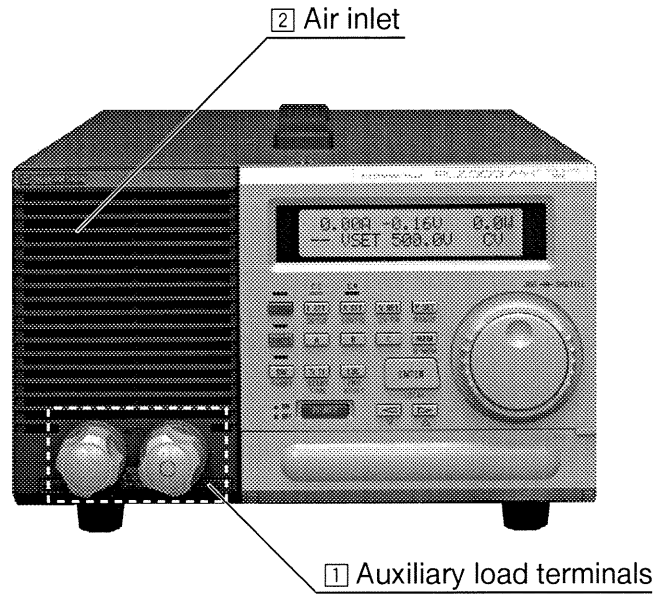
Chapter 3

Designations and Basic Functions of Controls

This chapter describes the designations and basic functions of the controls positioned on the front and rear operation panels. Detailed explanations of functions, operating modes, set values, and operating procedures are explained in Chapter 4, "Operating Procedure".

3.1 Front Panel Layout	3-2
3.2 Rear Panel Layout	3-8

3.1 Front Panel Layout



1 Auxiliary load terminals (for PLZ153WH or PLZ303WH only)

Terminals to which equipment to be tested is connected, so that currents flow in a simple manner. While these terminals are directly connected to the load terminal on the rear panel, they may not meet the load unit specifications.

WARNING

- Do not touch the auxiliary load terminals while the load unit is energized.
- Take care that the voltage applied to the auxiliary load terminals is output to the rear panel load terminal.
- Once a device to be tested is connected to these auxiliary load terminals, no other devices may be connected to the rear panel load terminal.

CAUTION

- Connect only conductors having appropriate wire diameter and cover to the terminals.
- Connect terminals and conductors with correct polarities.
- Do not apply any overvoltage to these terminals.

2 Air inlet

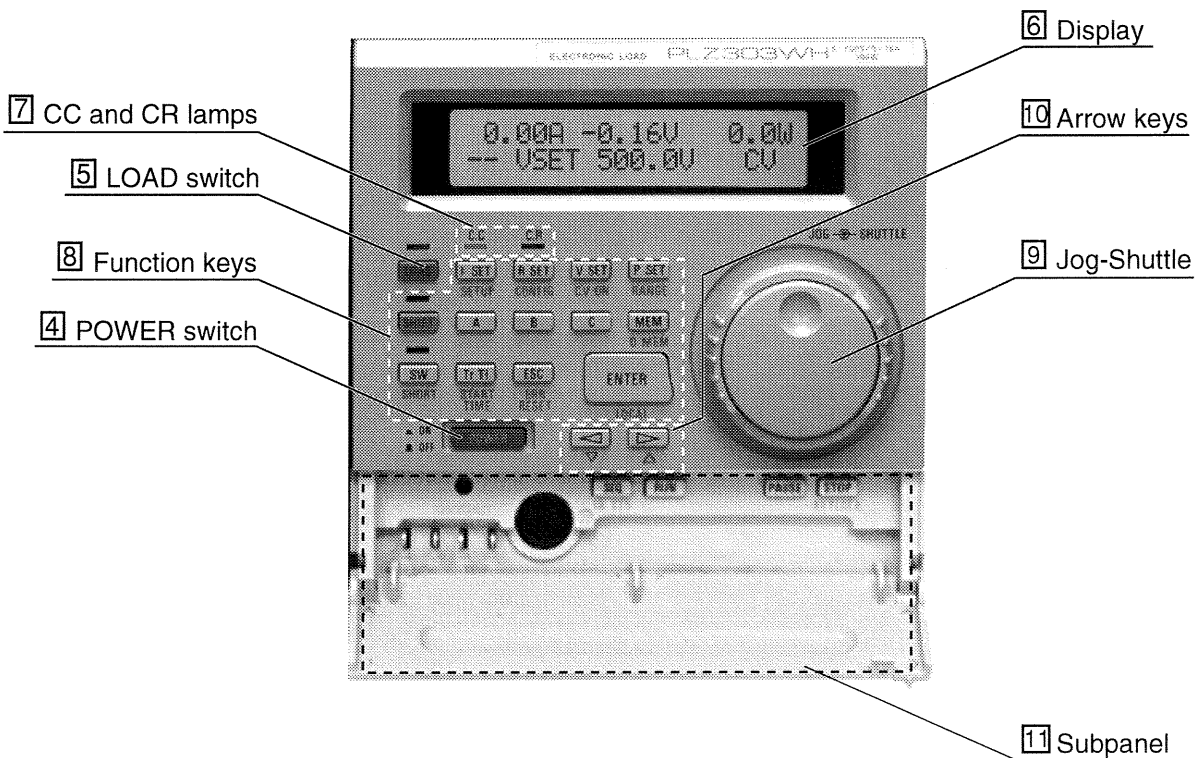
Takes in the air used in cooling the load unit interior.

CAUTION

- Do not block the air inlet.
- Inspect the dust filter periodically (see Chapter 6, "Maintenance and Calibration").

3 Handle (for PLZ603WH or PLZ1003WH only)

To move the load unit, the handles should be pulled out.



4 POWER switch

Whenever you press this switch, the load unit is turned on or off (depending on its current status). Since the load unit functions are automatically diagnosed after a power-on, you cannot operate the unit for about 2 seconds.

5 LOAD switch

Turns on/off the current in the load unit.
After this switch is turned on, the LED above it lights up (in green)

6 Display

Indicates set and measured values with respect to current, resistance, voltage, and power; also indicates parameters, menus, and messages.

7 CC and CR lamps

When you press the [I SET] key, the CC lamp goes on (in red) to indicate that the CC mode is active.
When you press the [R SET] key, the CR lamp goes on (in yellow) to indicate that the CR mode is active.

8 Function keys (see Chapter 4 for details on functions and operating procedures)

I SET (SET UP)

When you press this key, the CC mode is active. The CC lamp above the key goes on (in red), and "ISET" appears on the display. The set constant current (ISET) can be changed using the jog-shuttle.

If you press this key while also holding down the [SHIFT] key, the SET UP function is selected and the setup function menu appears on the display. From the menu, you can initialize the set values, and save (call) these values to (from) the setup memory.

R SET (CONFIG)

When you press this key, the CR mode is active. The CR lamp above the key goes on (in yellow), and "RSET" appears on the display. The set constant resistance (RSET) can be changed using the jog-shuttle. After you press this key while holding down the [SHIFT] key, the CONFIG function is selected and the configuration menu -- which allows you to set the conditions for various auxiliary functions -- appears on the display.

V SET (CV ON)

When you press this key in the CV mode, the set constant voltage (VSET) appears on the display. If you press this key while also holding down the [SHIFT] key, the CV ON function is selected, CV mode is active, and "CV VSET" appears on the display. You can change the set constant voltage (VSET) using the jog-shuttle.

P SET (RANGE)

When you press this key, "PSET" appears on the display. You can change the set constant power (PSET) using the jog-shuttle.

If you press this key while also holding down the [SHIFT] key, the RANGE function is selected. With this function, whenever the P SET key is depressed, a range H or L is selected for the CC or CR mode.

SHIFT

An additional function is indicated in blue under all keys except the [A], [B], [C], and [LOAD] keys. To select these added functions, press the desired key while also holding down the [SHIFT] key. After you press the [SHIFT] key, the lamp above it goes on (in green).

A

Calls and displays the set values stored to the memory A. In memory storage mode, select memory A.

B

Calls and displays the set values stored to the memory B. In memory storage mode, select memory B.

C

Calls and displays the set values stored to the memory C. In memory storage mode, select memory C.

MEM (DMEM)

Selects the memory storage mode. When you press the [A], [B], or [C] key in this mode, the present set value and range are saved to the selected memory.

If you press this key while also holding down the [SHIFT] key, the saved data change function (DMEM) is selected. In this mode, only the set values stored to the memory A, B, or C can be changed; the present set values are maintained.

SW (SHORT)

Selects or cancels the switching function. After the switching function is selected, the LED above the key goes on. In this mode, you can call the CC or CR mode settings saved to the memories one after another, and execute operations repeatedly.

If you press this key while also holding down the [SHIFT] key, the short function (SHORT) is selected. With this function, the maximum current (in CC mode) or minimum resistance (in CR mode) is set according to the presently selected mode.

TrTf (START TIME)

When you press this key in CC mode, the set current rise time and current fall time can be changed using the jog control.

If you press this key while also holding down the [SHIFT] key, the soft start function (START TIME) is selected. Using this function, a gentle current rise can be set in CC mode.

ESC (ERR RESET)

Cancels the presently selected function. As long as a menu is observed on the display, you can return to the previous menu or the menu one hierarchy above. If you press this key while also holding down the [SHIFT] key, the alarm reset function (ERR RESET) is selected and the alarm is reset.

ENTER (LOCAL)

Determines the input or changed set value. As long as a menu is observed on the display, you can go to the menu one hierarchy down.

After you press this key while holding down the [SHIFT] key, the local function (LOCAL) is selected. Under this function, operating control is transferred from external computer via the interface board, to the load unit panel. (See Chapter 5, "Remote Control".)

9 Jog-Shuttle

By turning the inner jog control, you can implement highly precise adjustments or selections of set values. By turning the outer shuttle control, you can adjust the set values more coarsely. The shuttle turn angle determines the setup speed.

10 Arrow keys

You should use these keys to select menu or setup items.

To select a skip number for a program edit in sequence mode, press the [◀] or [▶] keys while holding down the [SHIFT] key. The [◀] + [SHIFT] keys have the same function as the blue down (▽) key, and the [▶] + [SHIFT] keys have the same function as the blue up (△) key

11 Subpanel

When the cover is opened, you can observe monitor output terminals, trigger output terminals, remote control connector, sequence keys, memory card slot, and contrast control.

I MON OUT

An output terminal used to monitor currents. A voltmeter or oscilloscope is connected to this terminal.

TRIG OUT

A trigger signal output terminal.

J1

A connector for remote control. A dedicated remote controller such as the (optional) RC11 or RC02-PLZ is plugged in this connector.

Sequence keys

- **SEQ (IB STS)**

When you press this key, the sequence mode menu appears.

If you press this key while also holding down the [SHIFT] key, the GPIB status display function (IB STS) is selected and the status appears on the display.

- **RUN**

When you press this key, the sequence operation starts.

- **PAUSE**

When you press this key, the sequence operation is suspended temporarily.

- **STOP (KEYLOCK)**

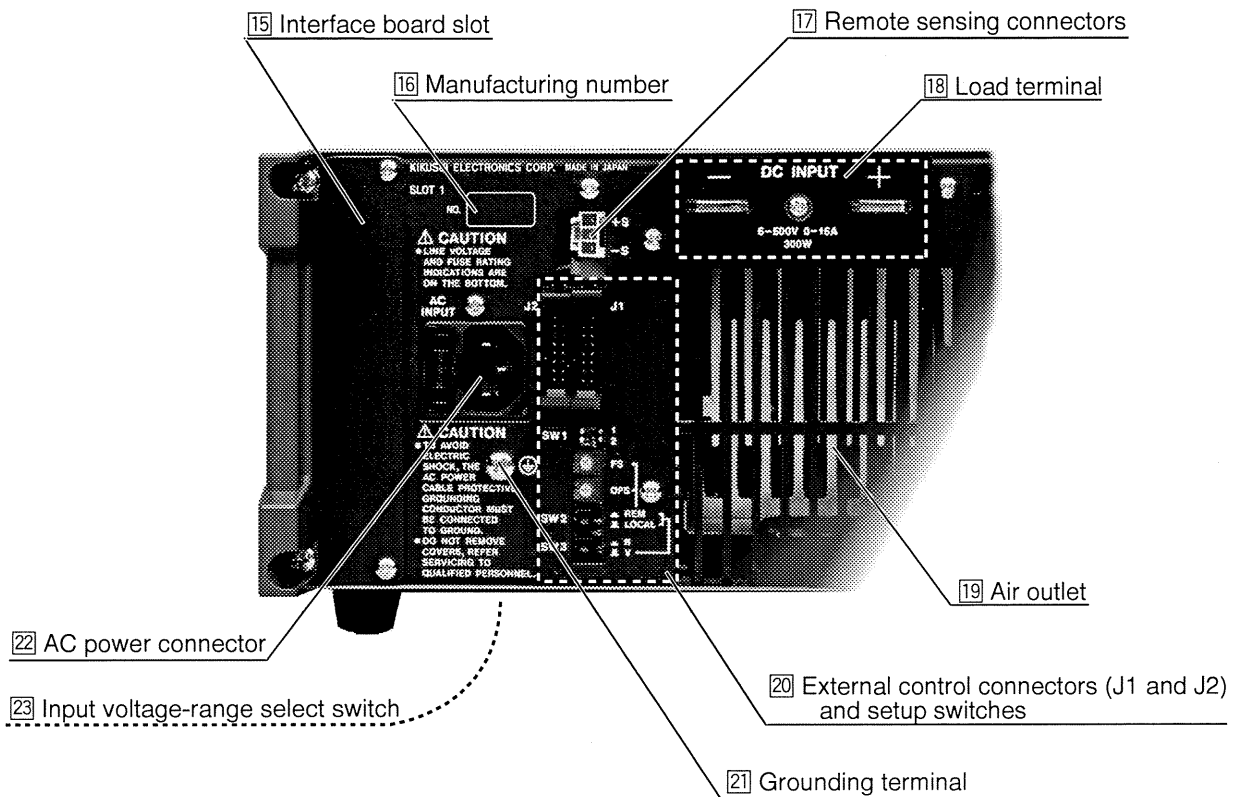
When you press this key, the sequence operation is completed.

If you press this key while also holding down the [SHIFT] key, the keylock function (KEYLOCK) is selected and the panel key operations are disabled.

CONTRAST

To adjust the contrast of the display, turn this variable resistor.

3.2 Rear Panel Layout



15 Interface board slot

A slot into which the optional interface board is inserted. The mountable interface board is IB11 (for GPIB), RS11 (for RS-232C), and MC11S (for MCB).

CAUTION

Before mounting or demounting the board, be sure to turn off the [POWER] switch.

16 Manufacturing number

The manufacturing number of your PLZ-3WH series electronic load unit.

17 Remote sensing connector

Connectors into which the accompanying remote sensing wire kit is plugged in order to compensate for the voltage drop induced by the resistance of load wires.

18 Load terminal

A terminal into which the equipment to be tested is connected, in order to supply the necessary currents. For PLZ153WH and PLZ303WH load units, this terminal is directly connected to the auxiliary load terminals located on the front panel.

WARNING

- Do not touch this load terminal while the load unit is energized.
- For PLZ153WH and PLZ303WH load units, take care that the voltage applied to the auxiliary load terminals is output to this load terminal.
- For PLZ153WH and PLZ303WH load units, once the equipment to be tested is connected to the auxiliary load terminals, no other devices may be connected to this load terminal.

CAUTION

- Use only load wire having appropriate wire diameter and cover.
- Connect the load terminal and conductor with correct polarities.
- Always connect the cable to the load terminal using the accompanying bolts.
- Do not apply any overvoltage to the load terminals.

19 Air outlet

An outlet through which the cooling fan air is exhausted.

CAUTION

- Take note that the temperature of the exhaust air is as high as 40°C.
- To ensure that exhaust air exits from the load unit smoothly, provide at least 30 cm of open space behind it.

20 External control connectors (J1 and J2) and setup switches

These connectors and their associated setup switches are used to input and output the signals to control the following functions, by means of external voltage, resistance, and/or switch.

External control function

- CC mode control by means of external voltage
- CC mode control by means of external resistance
- CR mode control by means of external voltage
- CR mode control by means of external resistance
- CP mode control by means of external voltage
- Load on/off control
- Range select control
- Trigger signal input/output
- Short function output
- Parallel run
- Alarm output

SW1-1

To operate multiple load units in parallel, turn on this switch at each slave unit.

SW1-2

A function extension switch. In the standard configuration, this switch is not used.

FS

Use this switch to adjust the maximum current or minimum resistance while in external control mode.

OFS

Use this switch to adjust the current offset or maximum resistance while in external control mode.

SW2

The REM position should be selected to control the load unit using external voltage; the LOCAL position, to control the load unit using external resistance.

SW3

The V position should be selected to control the load unit using external voltage; the R position, to control the load unit using external resistance.

————— NOTE —————

When the external control of CC mode or CR mode is not used, set the [SW2] to the LOCAL position and the [SW3] to the V position.

21 **Grounding terminal**

A terminal used to ground the load unit. If the load unit is not grounded via the AC power cable, use this terminal.

————— WARNING —————

- To run the load unit, be sure to ground it first. Otherwise, an electric shock hazard will exist.
- Connect the grounding terminal to electrical ground (safety ground.)

22 **AC power connector**

A fuse holder built-in type connector into which the AC power cable is plugged. A spare fuse is provided within this connector.

23 **Input voltage-range select switch (on the bottom face)**

Set this switch to an appropriate range according to line voltage.

————— WARNING —————

- To set these switches, turn off the [POWER] switch and disconnect the AC power cable.
- Be sure to use the specified fuse.

4

Chapter 4 Operating Procedure

This chapter describes basic functions and operating procedures of the load unit.

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4.1 Status of Display After Power-on

After you press the [POWER] switch on the front panel to turn on the load unit, a message will appear on the display.

PLZ153WH	7.5A	150W
I/F None		

In this initial example, the upper field shows the series model, rated current, and rated power of your load unit. The lower field shows the connecting status of the interface board (meanings are as follows).

- I/F None An interface board is not connected.
- I/F GP01 A GPIB interface board is connected. (The device address is "01".)
- I/F RS96 An RS-232C interface board is connected. (The baud rate is 9600 bps.)
- I/F MC01 An MCB interface board is connected. (The device address is "01".)

▼ Status of display after about 2 seconds

PLZ153WH	7.5A	150W
Ver 1.00		

The ROM-version information appears in the lower field as shown at left, about 2 seconds after the appearance of the initial message.

After another approximately 2 seconds, the information on the display is completely changed as follows.

▼ Status of display after about 2 seconds

0.000A	0.00V	0.0W
-- ISET 0.000A H --		

The upper field shows the current, voltage, and power being supplied to the load terminal of the load unit. The lower field shows the operating mode ("ISET" in this example shows that the constant current mode is active), set value (0.000A is set in this example), and range (range H is set in this example).

4.2 Basic Operations on Front Panel

This section explains basic operating procedures for the front panel keys.

Selecting the function

The basic function of the load unit can be selected by simply pressing the corresponding key. To escape from the presently selected key function, press the same key or the [ESC] key.

Operating the [SHIFT] key

To enable the function indicated in blue characters under a key, the [SHIFT] key must be used. You can press the [SHIFT] key in either of the following two ways. (Each way leads to the same result.)

- Press only the [SHIFT] key, then press the desired function key. After the [SHIFT] key is depressed, the LED (green) above it goes on to indicate that the blue-character function can now be selected.
- Press the desired function key while holding down the [SHIFT] key.

In this manual, the simultaneous operation of two keys is described as follows. (This example shows selection of the setup function).

[SHIFT] + [I SET] (SET UP)

Using the hierarchical menu

To select a function not assigned to a key, use the hierarchical menu. To select the menu item displayed, use the [◀] and [▶], [ENTER], or [ESC] keys.

When the menu displayed contains submenus in the lower hierarchies, the submenu one hierarchy down appears whenever you press this [ENTER] key. To return to the submenu in the upper hierarchy, press the [ESC] key. To select a menu item, use the [◀] and/or [▶] key. To select the set value, use the jog control.

Alarm against key errors by operator

Anytime you press an invalid key during operation, the buzzer sounds.

4.3 Constant Current, Constant Resistance, Constant Voltage, and Constant Power Modes

The following four operating modes are available on the PLZ-3WH series electronic load unit.

- Constant current mode (CC mode)
- Constant resistance mode (CR mode)
- Constant voltage mode (CV mode)
- Constant power mode (CP mode)

■ **Basic operation of CC mode (see Fig. 4.3-1)**

Once the current is set, the set current is defined as a constant current and supplied to the load unit to ensure a constant-current load. In CC mode specifically, even if the constant-voltage power supply changes its voltage (V_1), the input current (I) is not changed.

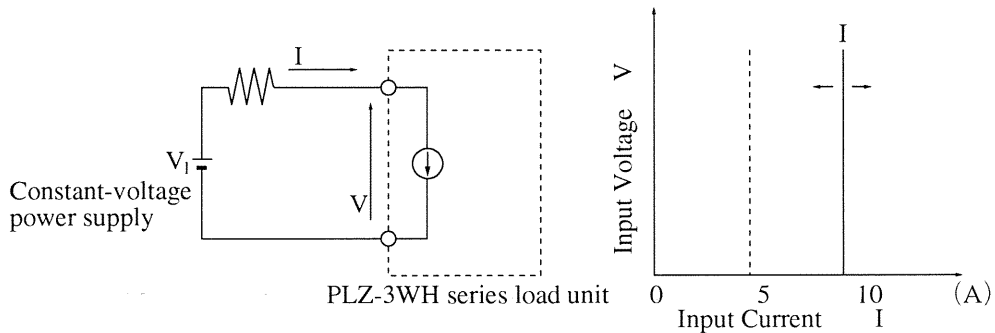


Fig. 4.3-1

■ **Basic operation of CR mode (see Fig. 4.3-2)**

Once the resistance is set, the input voltage and current are changed to keep the set resistance constant and thus to ensure a constant-resistance load. In CR mode specifically, even if the constant-voltage power supply changes its voltage (V_1), the input voltage (V) and input current (I) are altered so that V/I always equals to the set resistance (R).

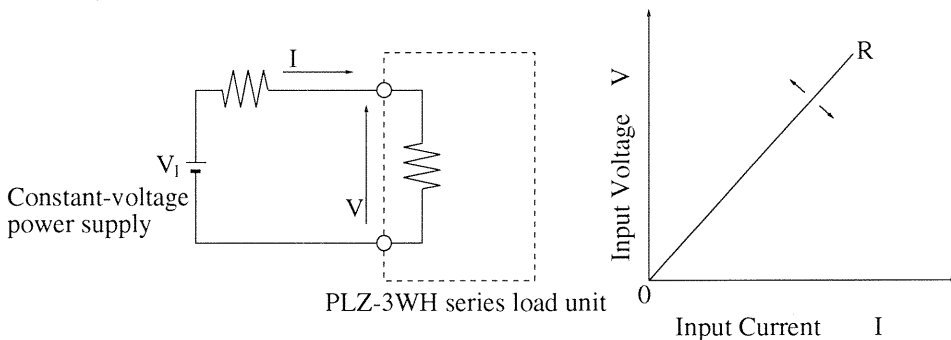


Fig. 4.3-2

■ Basic operation of CV mode (see Fig. 4.3-3)

Once the voltage is set, the input voltage becomes constant to maintain the set voltage and ensure a constant-voltage load. In CV mode specifically, even if the voltage (V_1) of the constant-voltage power supply is increased and the input current (I) subsequently increases, the input voltage (V) is maintained at the set level.

Unless the relation " $V_1 > V$ " is established, the input current (I) will not flow. Also, the load unit may work incorrectly depending on the resistance (R_1).

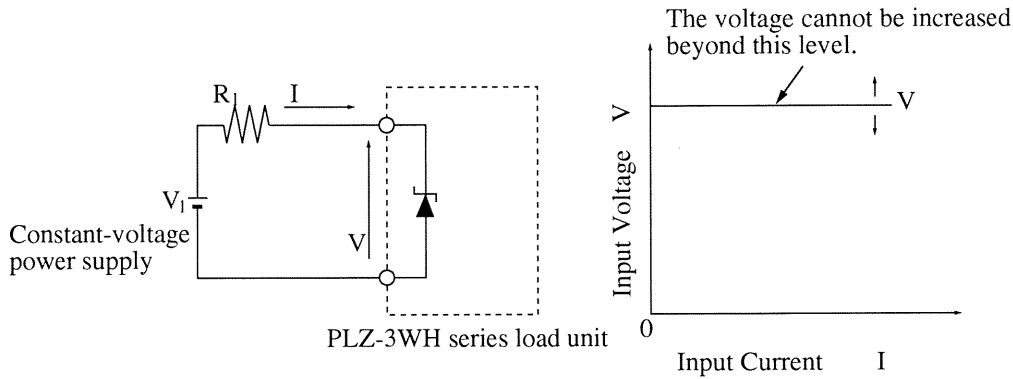


Fig. 4.3-3

■ Basic operation of CP mode (see Fig. 4.3-4)

Once the power is set, if the voltage of the constant-voltage power supply is increased, input current is decreased to ensure the power consumed in this load unit as a constant-power load.

In CP mode specifically, if the voltage (V_1) of the constant-voltage power supply is increased, the input current (I) is decreased to maintain the power (P) at the set level (i.e., " $P = V \times I$ " will be constant).

In the figure below, $V_2 \times I_2 = V_3 \times I_3 = V \times I$.

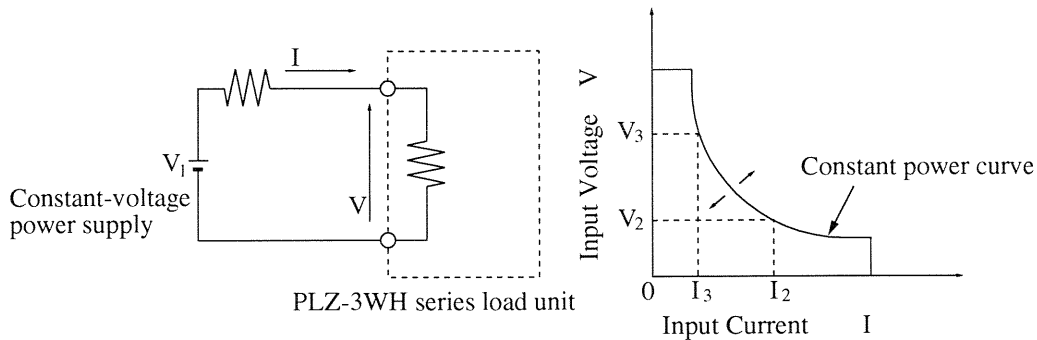


Fig. 4.3-4

■ Operating range of the PLZ-3WH series electronic load unit

Since the operation of this load unit is restricted by the rated current, voltage, and power, the load unit is permitted to work within the hatched area shown in the figure at right. If the input voltage is less than 5 V, the rated current cannot be supplied and, therefore, the specifications of the load unit are not met.

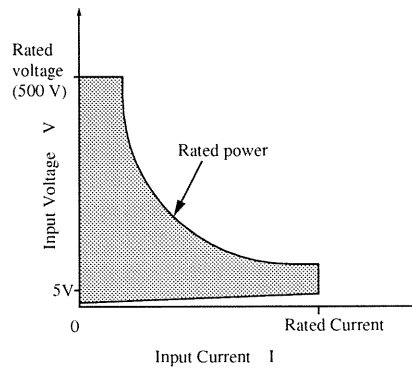


Fig. 4.3-5

■ Operating point of the PLZ-3WH series electronic load unit

The operating point of this load unit varies depending on the operating mode used and the set value(s). The point also depends on the voltage and current conditions of the equipment to be tested.

This subsection describes the transition of the operating point (i.e., a mode transition) when the input voltage or current is changed in the basic CC and CR modes.

◎ Transition of operating point in CC mode

In the figure at right, the operating point of CC mode lies on the line A-B; the operating point of CP mode lies on the line B-C. When the voltage (V_1) of the constant-voltage power supply is increased, the load unit works in CC mode, starting from point A. When the voltage arrives at point B, CP mode takes over from CC mode. When V_1 is further increased, the current is decreased. (See "Basic operation of CC mode," explained above.)

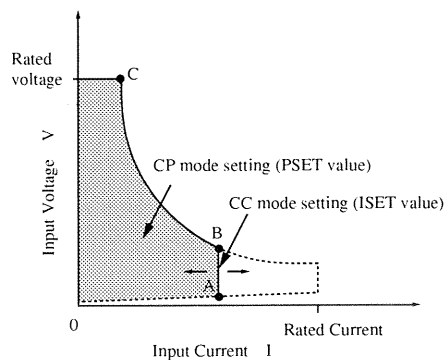


Fig. 4.3-6

After the CV mode is selected using [SHIFT] + [V SET] (CV ON) keys, the operating point is shifted as shown in the figure at right. In CV mode, the operating point should lie on the line E-D.

In CV mode, if the voltage (V_1) of the constant-voltage power supply exceeds the input voltage (V) (i.e., $V_1 > V$), a current flows so as to keep V constant. After V_1 is increased to point D, CC mode takes over from CV mode. (See "Basic operation of CV mode," explained above.) When V_1 is further increased, CP mode takes over from CC mode.

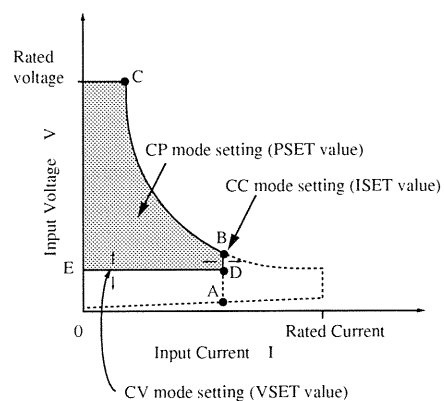


Fig. 4.3-7

☉ Transition of operating point in CR mode

In the figure at right, the operating point of CR mode lies on the line F-G and the operating point of CP mode lies on the line G-H. When the voltage (V_1) of the constant-voltage power supply is increased, the load unit works in CR mode, starting from point F. When the voltage arrives at point G, CP mode takes over from CR mode. (See "Basic operation of CR mode," explained above.)

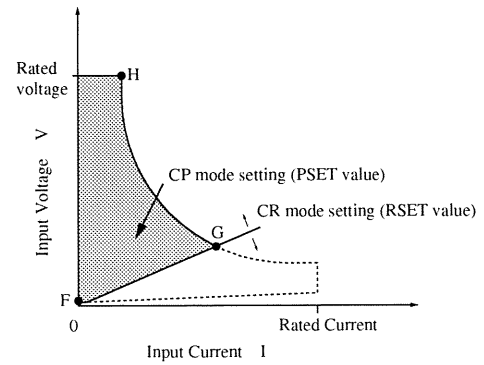


Fig. 4.3-8

After the CV mode is selected using [SHIFT] + [V SET] (CV ON) keys, the operating point is shifted as shown in the figure at right. In this CV mode, the operating point should lie on the line J-I.

In CV mode, if the voltage (V_1) of the constant-voltage power supply exceeds the input voltage (V) (i.e. $V_1 > V$), a current flows so as to keep V constant. After V_1 is increased to point I, CR mode takes over from CV mode. (See "Basic operation of CV mode," explained above.) When V_1 is further increased, CP mode takes over from CR mode.

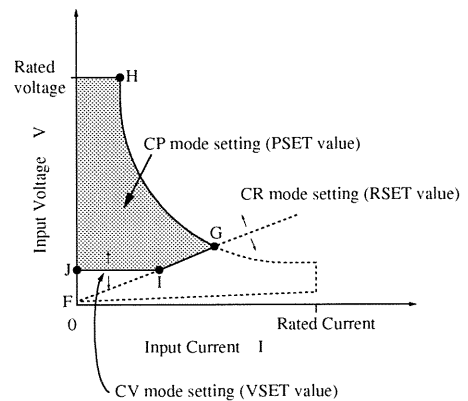
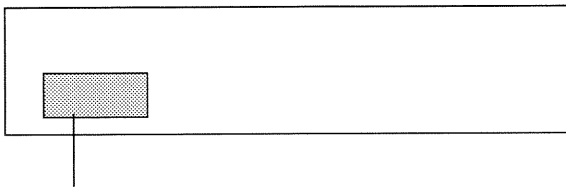


Fig. 4.3-9

☉ Mode indication on display

The currently selected operating mode is indicated on the bottom left of the display.



- CC Shows that the load unit is working in CC mode. The CC lamp (red) above the [I SET] key is also lit.
- CR Shows that the load unit is working in CR mode. The CR lamp (yellow) above the [R SET] key is also lit.
- CV Shows that the load unit is working in CV mode.
- CP Shows that the load unit is working in CP mode.
- - Shows that the load unit is not in any of the above modes.

4.4 Basic Operating Procedures

This section explains the basic operating procedures for the PLZ-3WH series electronic load unit, using the front panel of model PLZ153WH.

The explanation of each operating procedure is based on the precondition that the load unit has already been initialized. To initialize the load unit, press [SHIFT] + [I SET] (SET UP) keys, select the menu item "1: Initialize Setup" displayed hereafter, and press the [ENTER] key.

The set current for the CC mode is represented by "ISET value", the set resistance for the CR mode is represented by "RSET value", the set voltage for the CV mode is represented by "VSET value", and the set power for the CP mode is represented by "PSET value".

4.4.1 Operation in CC Mode

(a) Basic operation

● Preliminary setup

Check that "- -" is visible on the bottom right of the display. If a "CV" is observed, press [SHIFT] + [V SET] (CV ON) keys to reset the CV mode.

Press the [P SET] key to indicate "PSET" on the display, and set the PSET value using the jog-shuttle so that the value should be larger than the maximum test power, but also so that excessive power will not be taken from the equipment to be tested.

After the above initialize process is executed, the PSET value is automatically set to the maximum power of the load unit. If it is not necessary to change the setting, this preliminary process can be omitted.

● ISET value setup, load on/off, and range select

Based on the following exemplified conditions, this subsection explains how to set the ISET value to 5.00 A, turn on/off the load, and select the range in CC mode.

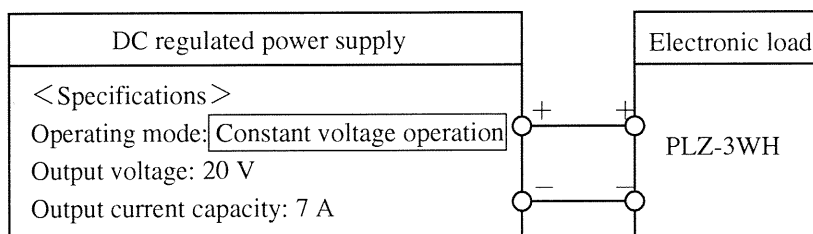


Fig. 4.4-1

- (1) Press the [I SET] key

Press the [I SET] key to turn on the CC lamp (red LED) above it and enable the CC mode.

"ISET" appears in the lower field of the display, and now you can set the ISET value. (Note: the figure on the right of "ISET" shows the present set value.) "H" shows the range H.

```
0.000A    20.0V    0.0W
-- ISET 0.000A H --
```

NOTE

When you press the [I SET] key with both the yellow CR lamp and [LOAD] switch is turned on, the [LOAD] switch is turned off.

- (2) Turn the shuttle control to set an approximate ISET value. Turning the shuttle control clockwise increases the value, while turning it counterclockwise decreases the value. The shuttle turning angle determines the adjustment speed.

```
0.000A    20.0V    0.0W
-- ISET 4.500A H --
```

- (3) Turn the jog control to set an accurate ISET value.

Turning the jog control clockwise increases the value minutely, while turning it counter-clockwise decreases the value minutely.

This completes the setting of the ISET value (in this example, it is set to 5.000 A). Next, proceed to the load on/off procedure.

```
0.000A    20.0V    0.0W
-- ISET 5.000A H --
```

- (4) Press the [LOAD] switch to turn on the lamp (green LED) above it. The current is supplied and the [LOAD] switch is turned on.

"CC" appears on the bottom left of the display to indicate that the load unit is active in CC mode. The presently set current, voltage, and power values now appear in the upper field of the display.

```
5.000A    19.9V    99.5W
CC ISET 5.000A H --
```

NOTE

When the voltage indication drops from an initial 20.0 V to 19.9 V, this is because the load effect on the DC-regulated power supply and/or a voltage drop in the load wires. The voltage drop in the load wires can be offset by remote sensing. (See Section 2.6.3, "Remote Sensing," of Chapter 2.)

- (5) To turn off the load, press the [LOAD] switch. The lamp above it goes off and the immediately previous information appears on the display.

```
0.000A    20.0V    0.0W
-- ISET 5.000A H --
```

CAUTION

If the inductance of the equipment to be tested or wires is very high, reduce the current to sufficiently low level before turning off the [LOAD] switch. (For your reference, the load on/off speed of this load unit is about 400 μ s.)

Next, proceed to the range select procedure.

(6) Press the [LOAD] switch to turn on the load. Using the jog-shuttle, set the ISET value. When the ISET value is changed with the [LOAD] switch turned on, the current of the load unit is changed accordingly. In this example, since the ISET value is changed to 6.000 A, the current indicated on the upper left is also changed to 6.000 A. (The present set range H is observed on the bottom right.)

6.000A	19.9V	119.4W
CC ISET 6.000A	H	--

(7) Press [SHIFT] + [P SET] (RANGE) keys to change the range. In this example, since L is selected, the current is limited to a maximum of the range L (0.7875 A here). You cannot set the ISET value in excess of this maximum.

0.788A	19.9V	15.7W
CC ISET 0.7875A	L	--

(8) To return the range to H, press [SHIFT] + [P SET] (RANGE) keys. Although the ISET value on the display is still maintained at the maximum current of range L, you can change it using the jog-shuttle.

0.788A	19.9V	15.7W
CC ISET 0.7875A	H	--

NOTE

The set resolution of the range L is 10 times as high as that of the range H. By contrast, the operating range of the range L is one tenth that of the range H.

(b) Setting the rise time and fall time

When you want to drastically change the set current in the CC mode using, for example, the jog-shuttle, sequence operation, memories, switching, or external control, you can change the rise time (T_r) and fall time (T_f). These determine the time duration until the current reaches the set value and the start value, respectively. However, this function is not applied to the load on/off operation.

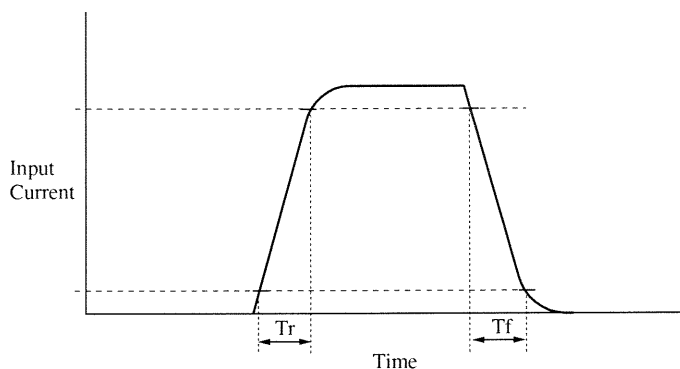


Fig. 4.4-2

When the equipment to be tested contains an L component, or you want to prolong the load wires, setting T_r and T_f to large values restricts the overvoltage induced by the L component.

CAUTION

If the L component of the wires, for example, is large and the load terminal voltage is specifically low, the load unit may oscillate due to its unstable operation.

● **Tr and Tf setup**

(1) Press the [TrTf] key. "TrTf" appears in the lower field of the display so that you can set the rise and fall times. The currently set TrTf value is observed on the right of this value (50μs in this example).

0.000A	12.0V	0.0W
--	Tr Tf	50μs

(2) Turn the jog control clockwise to select the set time (10 ms in this example). The following values can be selected.

0.000A	12.0V	0.0W
--	Tr Tf	10ms

50μs, 100μs, 200μs, 500μs, 1 ms, 2 ms, 5 ms, and 10 ms

(3) Press the [TrTf] key again or press the [ESC] key to return the display to its pre-setup status.

0.000A	12.0V	0.0W
--	ISET 6.000A H --	

(c) **Setting the soft-start rise time**

"Soft start" refers to a function in CC mode that permits the input current of the load unit to rise more gently than the output voltage of the equipment to be tested. When S_1 is turned on in the CC mode test configuration as illustrated below, the following relationship is established between input voltage (V) and input current (I) at a soft-start rise time of 0.5 ms.

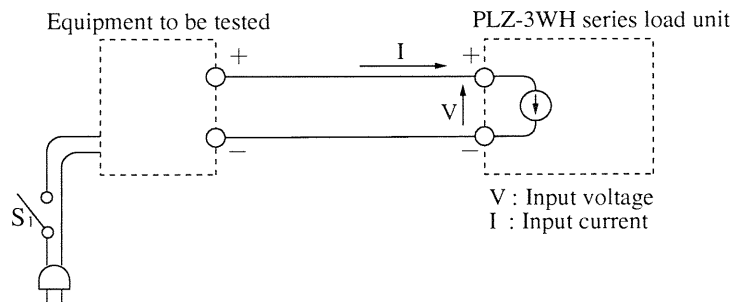


Fig. 4.4-3

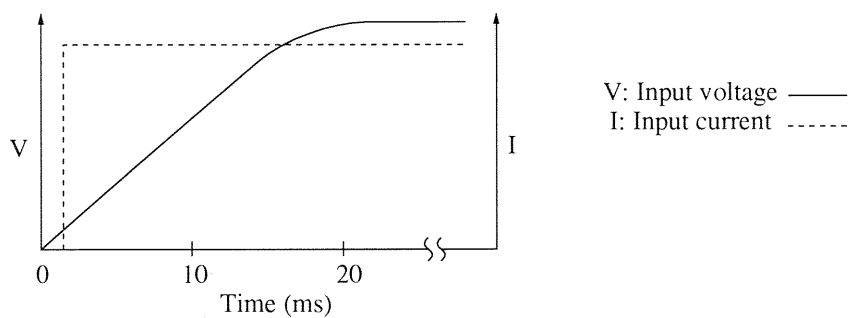


Fig. 4.4-4

When the soft-start rise time is set to 20 ms, the relationship shown in the figure below is established between the input voltage and current. If the soft-start rise time is appropriately set like this, the input current of the load unit rises almost immediately following the voltage rise of the equipment to be tested.

CAUTION

The time interval between on-off operations of the switch (S1: see Fig. 4.4-3) should be not less than 1 second.

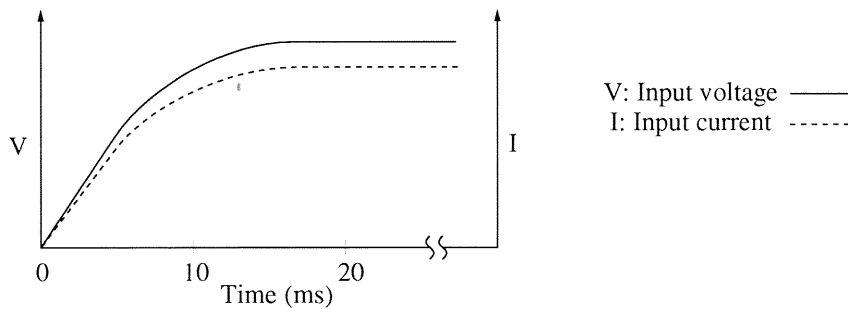


Fig. 4.4-5

● **Setting the soft-start time**

(1) Press [SHIFT] + [TrTf] (START TIME) keys. "START TIME" appears in the lower field of the display, and now you can set the soft-start rise time. The currently set value is observed on the right of this value (0.5 ms in this example).

0.000A	12.0V	0.0W
-- START TIME		0.5ms

(2) Turn the jog control clockwise to select the set time (20 ms in this example). The following values can be selected.

0.000A	12.0V	0.0W
-- START TIME		20ms

0.5, 1, 2, 5, 10, 20, 50, and 100 ms

(3) Press [SHIFT] + [TrTf] (START TIME) keys again or press the [ESC] key to return the display to its pre-setup status.

0.000A	12.0V	0.0W
-- ISET	6.000A	H --

4.4.2 Operation in CR Mode

● **Preliminary setup**

Check that "- -" is observed on the bottom right of the display. If "CV" is observed, press [SHIFT] + [V SET] (CV ON) keys to reset the CV mode.

Press the [P SET] key to indicate "PSET" on the display, and set the PSET value using the jog-shuttle so that the value should be larger than the maximum test power, but also so that excessive power will not be taken from the equipment to be tested.

After the above initialize process is executed, the PSET value is automatically set to the maximum power of the load unit. If it is not necessary to change your setting, this preliminary process can be omitted.

NOTE

If the current exceeds the rated value, the overcurrent protective circuit in the load unit works to limit the current and generate an alarm.

● RSET value setup, load on/off, and range select

Based on the following exemplified conditions, this subsection explains how to set the RSET value to 2.880Ω, turn on/off the [LOAD] switch, and select the range in the CR mode.

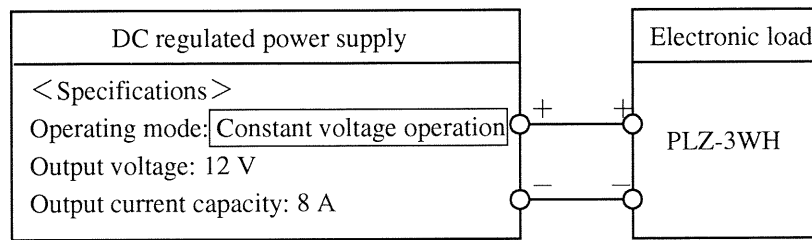


Fig. 4.4-6

- (1) Press the [R SET] key to turn on the CR lamp (yellow LED) above it and enable the CR mode.

"RSET" appears in the lower field of the display, and now you can set the RSET value. (Note: the figure on the right of "RSET" shows the present set value.) "H" shows the range H.

0.000A	12.0V	0.0W
-- RSET	20000Ω	H --

NOTE

When you press the [R SET] key with both the red CC lamp and [LOAD] switch is turned on, the [LOAD] switch is turned off.

- (2) Turn the shuttle control to set an approximate RSET value. Turning the shuttle control clockwise decreases the value, while turning it counterclockwise increases the value. The shuttle turning angle determines the adjustment speed.

0.000A	12.0V	0.0W
-- RSET	3.000Ω	H --

- (3) Turn the jog control to set an accurate RSET value.

Turning the jog control clockwise decreases the value minutely, while turning it counterclockwise increases the value minutely.

This completes the setting of the RSET value (in this example, it is set to 2.880Ω). Next, proceed to the load on/off procedure.

0.000A	12.0V	0.0W
-- RSET	2.880Ω	H --

- (4) Press the [LOAD] switch to turn on the lamp (green LED) above it. The current is supplied and the [LOAD] switch is turned on.

"CR" appears on the bottom left of the display to indicate that the load unit is active in CR mode. Presently set current, voltage, and power values now appear in the upper field of the display.

4.132A	11.9V	49.2W
CR RSET	2.880Ω	H --

NOTE

If the voltage indication drops from initial 12.0 V to 11.9V, the cause is the load effect on the DC-regulated power supply and/or the voltage drop in the load wires. The voltage drop in the load wires can be offset by remote sensing. (See Section 2.6.3, "Remote Sensing," of Chapter 2.)

- (5) To turn off the load, press the [LOAD] switch. The lamp above it goes off and the immediately previous information appears on the display.

0.000A	12.0V	0.0W
-- RSET	2.880 Ω	H --

CAUTION

If the inductance of the equipment to be tested or the wires is very high, reduce the current to sufficiently low level before turning off the [LOAD] switch. (For your reference, the load on/off speed of this load unit is about 400 μ s.)

Next, proceed to the range select procedure.

- (6) Press the [LOAD] switch to turn on the load. Using the jog-shuttle, set the RSET value. When the RSET value is changed with the [LOAD] switch turned on, the current of the load unit is changed accordingly. In this example, since the RSET value is changed to 1.700 Ω , the current indicated in the upper left is also changed to 7.018 A. (The present set range H is observed on the bottom right.)

7.018A	11.9V	83.5W
CR RSET	1.700 Ω	H --

- (7) Press [SHIFT] + [P SET] (RANGE) keys to change the range. In this example, since L is selected, the resistance is limited to a minimum of the range L (15.24 Ω in this example) and the current is decreased. You cannot set the RSET value below this minimum.

0.786A	11.9V	9.4W
CR RSET	15.24 Ω	L --

- (8) To return the range to H, press [SHIFT] + [P SET] (RANGE) keys. Although the RSET value on the display is still maintained at the minimum resistance of the range L, you can change it using the jog-shuttle.

0.786A	11.9V	9.4W
CR RSET	15.24 Ω	H --

NOTE

The set resolution of the range L is 10 times as high as the range H. By contrast, the operating range of the range L is one tenth that of the range H.

4.4.3 Operation in CV Mode

The CV mode is effective for testing the constant-current operation of the connected equipment.

● Preliminary setup

Press the [P SET] key to indicate "PSET" on the display, and set the PSET value using the jog-shuttle so that the value should be larger than the maximum test power, but also so that excessive power will not be taken from the equipment to be tested.

At this time, set the ISET value above the allowable input current of the equipment to be tested (7 A in this example), and set the RSET value above the level determined by the allowable input current of the equipment.

● VSET value setup and load on

Based on the following exemplified conditions, this subsection explains how to set the VSET value to 15 V and to turn on the load in CV mode.

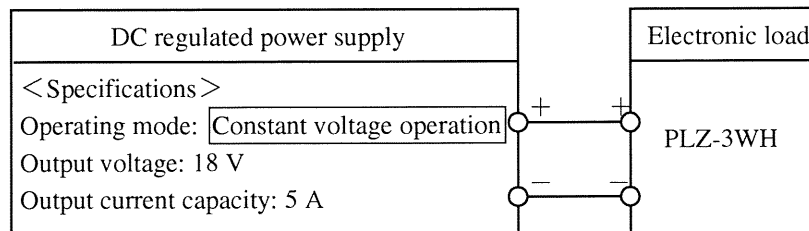


Fig. 4.4-7

- (1) Press [SHIFT] + [V SET] (CV ON) keys. "CV" appears on the right bottom of the display and the CV mode is enabled.

0.000A	18.0V	0.0W
-- ISET	7.000A	H CV

- (2) Press the [V SET] key. "VSET" appears in the lower field of the display, and now you can set the VSET value (the figure on the right of "VSET" shows the present set value).

0.000A	18.0V	0.0W
-- VSET	0.00V	H CV

- (3) Using the jog-shuttle, set the VSET value below the output voltage of the DC-regulated power supply (18 V in this example). (The VSET value is set to 15.00 V here).

0.000A	18.0V	0.0W
-- VSET	15.00V	H CV

- (4) Press the [LOAD] switch. The lamp (green LED) above it goes on, and "CV" appears on the bottom left of the display to indicate that the load unit is active in CV mode. Presently set current, voltage, and power values now appear in the upper field of the display. This permits the maximum current of the power supply to flow (in this example, the 5.000 A indicated on the upper left of the display).

5.000A	15.0V	75.0W
CV VSET	15.00V	H CV

NOTE

- Note that if the ISET value is lower than the constant current set to the DC-regulated power supply, the load unit will not work in CV mode.
- When the mode is changed from CC or CR mode to CV mode, the voltage may have overshoot or undershoot depending on the output capacitor or response speed of the DC-regulated power supply. To mitigate such an event, set the VSET value to such a high level that the CV mode is disabled; then, turn on the [LOAD] switch and lower the set value to enable the CV mode. The overshoot or undershoot can also be reduced by approaching the set value to the target value.

4.4.4 Operation in CP Mode

● Preliminary setup

Check that a "--" is visible on the bottom right of the display. If a "CV" is observed, press [SHIFT] + [V SET] (CV ON) keys to reset the CV mode.

At this time, set the ISET value above the allowable input current of the equipment to be tested (7 A in this example), and set the RSET value above the level determined by the allowable input current of the equipment.

● PSET value setup and load on

Based on the following exemplified conditions, this subsection explains how to set the PSET value to 80 W and to turn on the [LOAD] switch in CP mode.

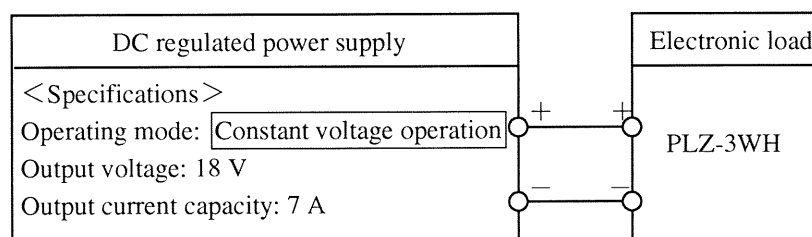


Fig. 4.4-8

- (1) Press the [P SET] key. "PSET" appears in the lower field of the display, and now you can set the PSET value (the figure on the right of "PSET" shows the present set value).

0.000A	18.0V	0.0W
-- PSET	157.5W	--

- (2) Using the jog-shuttle, set the PSET value (to 80.0 W, in this example).

0.000A	18.0V	0.0W
-- PSET	80.0W	--

- (3) Press the [LOAD] key. The lamp (green LED) above it goes on, and the current is supplied to turn on the [LOAD] switch.

4.460A	17.9V	79.8W
CP PSET	80.0W	--

"CP" appears on the bottom left of the display to indicate that the load unit is active in CP mode. The upper field of the display shows presently set current, voltage, and power values.

NOTE

- If the voltage indication drops from initial 18.0 V to 17.9 V, this is because of a load fluctuation on the DC-regulated power supply and/or a voltage drop in the load wires. The voltage drop in the load wires can be offset by remote sensing. (See Section 2.6.3, "Remote Sensing," of Chapter 2.)
- When you enter into CP mode by promptly turning on the [LOAD] switch, an overshoot may occur on the current.

4.4.5 Saving and Calling Set Values

The following set values can be saved to and called from any of memories A, B, and C based on your application and user requirements.

- CC mode: ISET value, set range, set switching execution time
- CR mode: RSET value, set range, set switching execution time
- CV mode: VSET value
- CP mode: PSET value

NOTE

For details on switching functions and memory utilization, see also Section 4.4.6, "Switching Functions".

(a) Save to memory and modification of memory contents

To save the set value and range to the memory, use the [MEM] key. To set and save the switching execution time, and modify the saved set value and range, press [SHIFT] + [MEM] (DMEM) keys.

You can save the data to the memory whether the [LOAD] switch is turned on or off. In the example herein, the data are saved to the memory in the load on state.

● Saving the data with [MEM] key

To save the set value and range presently indicated on the display, use the following procedure.

- (1) Press the [I SET], [R SET], [P SET], or [V SET] key to select the operating mode for the set values you want to save.

In this example, the CC mode is active and the presently set ISET value and range are observed on the display.

5.000A	12.0V	60.0W
CC ISET	5.000A	H --

- (2) To modify and save the presently set values, use the jog-shuttle for the ISET value and [SHIFT] + [PSET] (RANGE) keys for the range.

In this example, you will modify the ISET value to 7.000 A but maintain the range H, and then save these values to a memory.

7.000A	12.0V	84.0W
CC ISET	7.000A	H --

- (3) Press the [MEM] key. "MEM<ABC>Save Mode" appears in the lower field of the display.

7.000A	12.0V	84.0W
CC	MEN<ABC>Save Mode	

- (4) Upon specification of the memory to which you want to save the data with the [A], [B], or [C] key, the ISET value and range are saved to the specified memory.

In this example, since the [A] key is depressed to select the memory A, "A" is observed on the bottom right of the display. To save the same data to another memory, press the [B] or [C] key in this state. "A" is replaced with "B" or "C" and the data is saved to the specified memory.

7.000A	12.0V	84.0W
CC	MEN<ABC>Save A	

- (5) After you press the [MEM] or [ESC] key, the display returns to the pre-save status. To save another set of data, repeat the procedure from step (1) or (2).

7.000A	12.0V	84.0W
CC ISET	7.000A	H --

● Modifying and saving the data with [SHIFT] + [MEM] (DMEM) keys

This procedure modifies only the contents stored to the memory and saves the modified data regardless of the present operating mode setting and range. This procedure is also used to set and save the switching execution time of CC and CR modes.

- (1) With the [LOAD] switch turned on, press the [I SET], [R SET], [P SET], or [V SET] key to select the operating mode for the set values saved.

5.000A	12.0V	60.0W
CC ISET	5.000A	H --

In this example, the CC mode is active and presently set ISET value and range are observed on the display.

- (2) Press [SHIFT] + [MEM] (DMEM) keys. "Ivalue" appears in the lower field of the display (the character in "<>" shows the memory to which the set value have been saved).

5.000A	12.0V	60.0W
CC Ivalue<A>	7.000A	

In this example, "7.000 A" on the right of "Ivalue" indicates the ISET value saved to the memory A. The maintained present value "5.000 A" is observed on the upper left.

To modify the saved set value, use the jog-shuttle. (The modified value will be resaved upon completion of this modify and save process.)

- (3) When you press the [▷] key, "Irange" appears instead of "Ivalue" in the lower field of the display, and now you can modify the set range.

5.000A	12.0V	60.0W
CC Irange<A>	High	

In this example, the "High" appearing on the bottom right shows that the CC mode current range saved to the memory A is H. To modify the range, use the jog control.

- (4) When you press the [▷] key, "Itime" appears instead of "Irange" in the lower field of the display, and now you can modify the set switching execution time.

5.000A	12.0V	60.0W
CC Itime	1ms	

In this example, to modify the set time saved to the memory B, press the [B] key to enter it into the memory B, and then press the [▷] key. The "1 ms" on the right bottom shows the saved set time. To modify the set time, use the jog control.

- (5) To move to another memory, press the corresponding memory key, and press the [◀] or [▷] key to move to the set value to be modified.

5.000A	12.0V	60.0W
CC Ivalue<C>	3.000A	

In this example, to modify the ISET value saved to the memory C, press the [C] key to enter it into the memory C, and then press the [◀] key twice. The subsequent process is the same as step (2) above.

- (6) Pressing [SHIFT] + [MEM] (DMEM) keys or [ESC] key returns the display to the pre-save status.

(b) Call-out from memory

Once the data are called from memory, they can immediately become active set values.

You can call the data from memory whether the [LOAD] switch is turned on or off. In the following example, the data is called from memory in the load on state.

- (1) Press the [I SET], [R SET], [P SET], or [V SET] key to select the operating mode for the set values you want to call.

5.000A	12.0V	60.0W
CC ISET	5.000A	H --

In this example, the CC mode is selected by the [I SET] key.

- (2) Using the [A], [B], or [C] key, specify the memory to which the desired set values have been saved. After you press the corresponding key, the saved set values appear in the lower field of the display; the set value in the upper field are also changed.

7.000A	12.0V	84.0W
CC ISET	7.000A	H --

In this example, an ISET value of 7.000 A is called from the memory A; the present set value of 5.000 A is replaced with this new value.

0.600A	12.0V	7.2W
CC ISET	0.600A	L --

In the example shown right, an ISET value of 0.600 A is called from the memory B to define as a new set value. Since the range L has been saved to the memory B, the range is also changed from H to L.

CAUTION

If you are not certain about the saved set values you want to call from the memory, be sure to check the data before replacing the present set values. Failure to check the data may result in damage to the equipment to be tested.

NOTE

When you want to check the saved set values called from memory before replacing the present set values, use the following procedure.

- Before calling the data, press [SHIFT] + [R SET] (CONFIG) keys to display the Configuration Menu, and select the menu item, "4: Recall ABC Mem." Specify "Safety" (see Section 4.4.9, "Configuration").
- This protects the present set values from being automatically replaced with the saved set values called as long as the [ENTER] key is not depressed. If improper set values are called, press the [ESC] key to cancel the operation and call the correct data again.

4.4.6 Switching Function

The CC and CR modes have a function such that the set values saved to memories A, B and C are called sequentially in alphabetical order, in order to repeatedly execute tests using these set values based on the execution time assigned to the selected mode. This is called a "switching function." The switching function is the best choice for conducting transient characteristic tests of a DC regulated power supply, for example.

● Preliminary setup

To use the switching function in CC mode, first provide the preliminary setup and setup of rise time (T_r) and fall time (T_f) as specified in Section 4.4.1, "Operation in CC Mode." Then save the set values you want to use to each memory. To use the switching function in CR mode, first provide the preliminary setup specified in Section 4.4.2, "Operation in CR Mode", and then save the set values you want to use to each memory.

NOTE

- The rise time and fall time of the current in CC mode can be changed using the [TrTf] key and jog control even while the switching function is active.
- In both the CC and CR modes, the set values and execution time can be changed using [SHIFT] + [MEM] (DMEM) keys while the switching function is active.
- Range H is always selected for the switching function, even if range L is saved to the memory.
- In CR mode, when a constant input voltage is specified, the switching operation defines the rise and fall times of the current each as 200 μ s.

● Switching operation (in CC mode)

When the following CC-mode data has been saved to the memories, the switching operation is executed in the manner shown in Fig. 4.4-9.

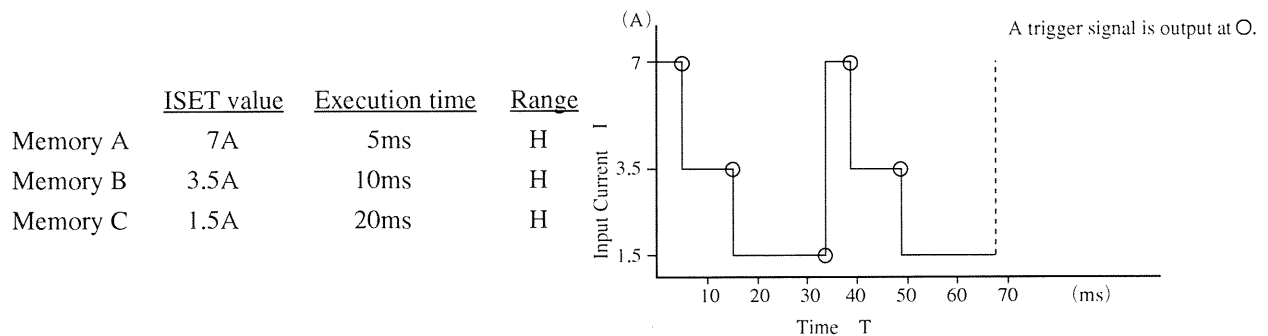


Fig. 4.4-9

NOTE

- To output a trigger signal when the switching operation is implemented, display the Configuration Menu using the [SHIFT] + [R SET] (CONFIG) keys, and select the menu item, "8: SW Trig Out." Specify "ON" (see Section 4.4.9, "Configuration"). This outputs the trigger signal at the points shown in the figure above.
- The trigger output terminal of the load unit is located on the subpanel (i.e., the bottom section of the front panel). The trigger signal can also be picked up from the external control connectors on the rear panel.

● Switching function operating procedure

- (1) Specify the operating mode in which you want to use the switching function.

In this example, the CC mode is selected using the [I SET] key. In CR mode, press the [R Set] key.

0.000A	12.0V	0.0W
-- ISET	6.000A	H --

NOTE

When CC mode is selected, the switching function is executed using the ISET values saved to memories A, B, and C. When CR mode is selected, the switching function is executed using the RSET values saved to memories A, B, and C.

- (2) Press the [SW] key. The (green LED) lamp above it goes on and the switching operation starts. The lower field of the display lists sequentially a set of memory names (to which the set value being executed is saved), set values, and execution times.

In this example, the memory name "C", set value "1.500 A", and execution time "20ms" can be seen. From the current, voltage, and power information in the upper field, you can see that the load is not yet turned on at this point.

0.000A	12.0V	0.0W
-- I < C >	1.500A	20ms

- (3) Press the [LOAD] switch. The (green LED) lamp above it goes on and the [LOAD] switch is turned on. "CC" appears on the bottom left of the display and the actual current, voltage, and power appear in the upper field.

1.500A	11.9V	17.9W
CC I < C >	1.500A	20ms

4.4.7 Keylock Function

The keylock function invalidates all keys as well as the jog shuttle positioned on the front panel, including the subpanel.

This function is enabled only by pressing the [SHIFT] + [STOP] (KEYLOCK) key. You can use this key sequence even while the key functions are disabled. The keylock function can be canceled by using the same key sequence.

● Keylock function operating procedure

- (1) Press the [SHIFT] + [STOP] (KEYLOCK) keys to activate the keylock function.

"<<Keys Locked>>" appears in the lower field of the display to show that the keylock mode is active.

0.000A	12.0V	0.0W
-- << Keys Locked >>		

- (2) To cancel the keylock function, press the [SHIFT] + [STOP] (KEYLOCK) keys again. The keys are unlocked and the display returns to its original status.

0.000A	12.0V	0.0W
-- ISET	7.500A	H --

NOTE

The keylock function cannot be canceled using the [ESC] key.

On the Configuration Menu, you can disable only the [SW] key, which is used to select switching and short functions; combinations of the [SW] and [SHIFT] keys, and the [A], [B], and [C] keys. To do so, first open the Configuration Menu with the [SHIFT] + [R SET] (CONFIG) keys. Then select the menu item, "6: SW Key" and set "Lock" for the [SW] key; select the menu item, "7: SHORT Key" and set "Lock" for the combination of the [SW] and [SHIFT] key; select the menu item, "5: ABC Key" and set "Lock" for the memory keys. (See Section 4.4.9, "Configuration".)

4.4.8 Setup Function and Backup Memory

The PLZ-3WH series electronic load unit automatically saves and maintains the setup status immediately before a power-off. You can also copy part or all of the set values listed below as setup values for backup purposes, so that the load unit can be easily set under various different conditions.

Four sets of setup values can be saved as backup data when you use the built-in backup memories.

The built-in backup memories are maintained by built-in chargeable batteries. These batteries are charged while the load unit is being turned on, and maintain the memory contents for about one month after turning off the power.

The setup values to be saved to the built-in backup memories are specified from the setup function menu.

The storable setup values and their defaults are as follows.

- Set configuration value (default at shipment from factory)
- Load power-on/power-off (off)
- ISET value (0 A)
- RSET value (maximum)
- VSET value (0 V)
- PSET value (maximum)
- CC/CR mode range (H)
- TrTf value (50 μ s)
- Soft start time setting (0.5 ms)
- CV on/off status (off)
- Contents of memories A, B, and C (above defaults are set for each operating mode)

To select the setup values you want to save, call the setup function menu. As saved values, you can specify all the above setup values (ALL); all the setup values except for the contents of memories A, B, and C (SET); or the contents of memories A, B, and C only (MEM). The setup function menu items and their contents are as follows (the operating procedure is shown on the next page).

- | | |
|---------------------|--|
| 1: Initialize Setup | Initializes all the setup values. |
| 2: Store [ALL] | Saves all the setup values to the backup memories. |
| 3: Recall [ALL] | Calls all the setup values from the backup memories. |
| 4: Store [SET] | Saves all the setup values, except for the contents of memories A, B, and C, to the backup memories. |
| 5: Recall [SET] | Calls all the setup values, except for the contents of memories A, B, and C, from the backup memories. |
| 6: Store [MEM] | Saves only the contents of memories A, B, and C to the backup memories. |
| 7: Recall [MEM] | Calls only the contents of memories A, B, and C from the backup memories. |

NOTE

After "1: Initialize Setup" is executed, the menu is automatically closed. To close the menu when other menu items have been executed, press the [ESC] key after completing the relevant operation.

● Setup procedure

(1) Press the [SHIFT] + [I SET] (SET UP) keys to select the setup function. The first item of the setup function menu appears on the display. If you want only to initialize the setup values, press the [ENTER] key. (After the data is initialized, the display automatically returns to its pre-setup-function-select status.)

```
> 1: Initialize Setup
      Push [ENTER]
```

(2) Only when you have executed the initialize process, press the [SHIFT] + [I SET] (SET UP) keys to select the setup function again. If the first item is still observed on the display, press the [▷] key to display the next item. (To return to the previous item, use the [◁] key.)

```
> 2: Store [ALL]
      1
```

In this example, the second item is observed and the figure in the lower field shows a memory number. Since numbers 1 to 4 are assigned to the built-in backup memories, up to four sets of setup values can be saved.

(3) To change the memory number on the present menu item, select the desired number with the jog control and press the [ENTER] key. Pressing the [ENTER] key immediately starts a data-save operation. When the message "Completed" appears and the display returns to the menu, the setup process is complete. (Use the same procedure when the "Recall" function is selected.)

```
> 2: Store [ALL]
      4
```

(4) To end the setup function, press the [ESC] key or [SHIFT] + [I SET] (SET UP) keys. The display returns to its pre-function-select status.

```
0.000A      5.0V      0.0W
-- RSET 5000.Ω  H --
```

4.4.9 Configuration

In configuration work, you select and set the operating conditions of the load unit using the Configuration Menu. After you press the [SHIFT] + [R SET] (CONFIG) keys, the Configuration Menu appears on the display. Only one menu item appears on the display. Therefore, press the [▷] key to move to the next item, and press the [◁] key to return to the previous item. Press the [ENTER] key to move to the menu one hierarchy below and press the [ESC] key to return to the menu one hierarchy above. To select the operating conditions for the menu, use the jog control. You can also use the shuttle control for items 10, 11, 12, and 13. To determine a selection or setting, press the [ENTER] key.

NOTE

After you press the [ENTER] key to determine a selection or setting, "Completed" appears if the data is saved successfully. If not, an error message appears and a buzzer sounds.

To close the configuration menu, press the [ESC] key or [SHIFT] + [R SET] (CONFIG) keys while the main menu is on display. Menu items and selectable operating conditions are as follows.

Configuration Menu and Operating Conditions

Configuration Menu

1: Power-on Load [OFF] [ON]	Determines the [LOAD] switch status when the [POWER] switch is turned on. Starts the load unit with the load turned off (default). Starts the load unit with the load turned on.
2: Power-on Keylock [OFF] [ON]	Selects the keylock status when the [POWER] switch is turned on. Starts the load unit with the keylock reset (default). Starts the load unit with the keylock active.
3: Preset [OFF] [ON]	Selects whether the set values should be determined with the [ENTER] key. Determines the set values without the [ENTER] key (default). Determines the set values by pressing the [ENTER] key.
4: Recall ABC Mem. [Direct] [Safety]	Selects whether the ABC memory should be determined with the [ENTER] key. Determines the ABC memory without the [ENTER] key (default). Determines the ABC memory by pressing the [ENTER] key.
5: ABC Key [Lock] [Unlock]	Selects whether the ABC memory keys should be operated. Prohibits key operation. Permits key operation (default).
6: SW Key [Lock] [Unlock]	Selects whether the [SW] key should be operated. Prohibits key operation. Permits key operation (default).
7: SHORT Key [Lock] [Unlock]	Selects whether the [SHORT] key should be operated. Prohibits key operation. Permits key operation (default).
8: SW Trig Out [OFF] [ON]	Selects whether a trigger signal should be output during switching. Disables the signal output (default). Enables the signal output.

- | | |
|----------------------|--|
| 9: Interface | Selects each interface operating environment. |
| 1: GPIB Address | GPIB address (the default is address 1). |
| 2: Power-on SRQ | Power-on service request |
| [Enable] | |
| [Disable] | (default) |
| 3: MCB Address | MCB address (the default is 15). |
| 4: RS-232C Speed | Baud rate |
| [9600 bps] | (default) |
| [4800 bps] | |
| [2400 bps] | |
| [1200 bps] | |
| 5: RS-232C Data bit | Data length |
| [8 bit] | (default) |
| [7 bit] | |
| 6: RS-232C Stop bit | Stop bit length |
| [1 bit] | |
| [1.5 bit] | |
| [2 bit] | (default) |
| 7: RS-232C Parity | Parity bit |
| [None] | (default) |
| [Odd] | |
| [Even] | |
| 10: Resolution (I) | Sets the current variation (resolution) per one jog click. (The default is 0.0100 A, but this value is set to 0.0010 A for the PLZ153WH.) |
| 11: Resolution (I/R) | Sets the resistance variation (resolution) per one jog click. (The default is 0.0100 siemens, but this value is set to 0.0010 siemens for the PLZ153WH.) |
| 12: Resolution (V) | Sets the voltage variation (resolution) per one jog click. (The default is 0.010 V.) |
| 13: Resolution (P) | Sets the power variation (resolution) per one jog click. (The default is 0.100 W.) |
| 14: Parallel Ope | Sets the number of load units to be operated in parallel. (The default is 1.) |
| 16: Calibration | Calibration |

4.4.10 Alarm

(a) Type, operation, and indication of alarm

The following table lists the types, operations, and indications of the alarms used on the PLZ-3WH series electronic load unit.

Table 4.4-1

Alarm type	Action	Indication (lower field of display)
Detection of reverse voltage	When a reverse voltage is applied to the load terminal, an alarm occurs and a buzzer sounds.	* ALARM* REVERSE
Detection of overvoltage	When voltage of at least 525 VDC is applied to the load terminal, an alarm occurs and a buzzer sounds. At the same time, the [LOAD] switch is turned off and the alarm output terminal level is switched to "L."	* ALARM* OVER-V
Detection of overheating	When the temperature of the internal power unit exceeds 100 °C, an alarm occurs and a buzzer sounds. At the same time, the [LOAD] switch is turned off and the alarm output terminal level is switched to "L."	* ALARM* OHP
Detection of fuse blow-out	When the fuse of the internal power unit is blown out, an alarm occurs and a buzzer sounds. At the same time, the [LOAD] switch is turned off and the alarm output terminal level is switched to "L."	* ALARM* FB3
Detection of overcurrent	When the current exceeds 105 % of the unit rating, an alarm occurs and a buzzer sounds. The input current is cut and limited to the 105 % level.	* ALARM* OCP
Detection of alarm input	An alarm is triggered by a signal from the alarm input terminal of the external control connector. When an alarm occurs, the [LOAD] switch is turned off and the alarm output terminal level is switched to "L."	* ALARM* EXT

NOTE

- The most recently detected alarm appears on the display.
- The alarm output terminal is located on the external control connector of the rear panel.
- When Detection of overvoltage, Detection of overheating, Detection of fuse blow-out or Detection of alarm input appears two times or more continuously or the alarm is reset at the cause of the alarm still exist, the PSET value is at 0.0W.
- Load-on state by contact signal at operates, when Detection of overvoltage, Detection of overheating, Detection of fuse blow-out or Detection of alarm input, however, load-lamp does not turn off the light even if it becomes Load-off.

(b) Alarm reset

While the alarm can be reset once by pressing the [SHIFT] + [ESC] (ERR RESET) keys, it will reappear as long as the factor causing it is not removed.

NOTE

- The overcurrent alarm is automatically reset when the alarm status is removed. Therefore, no further alarm reset operation is needed.
- When an alarm is triggered by the detection of an alarm input, first reset the alarm of the equipment connected to the external control connector, then reset the alarm of the load unit.
- The alarm output terminals on the rear panel external control connector are positioned as shown in the figure at right.

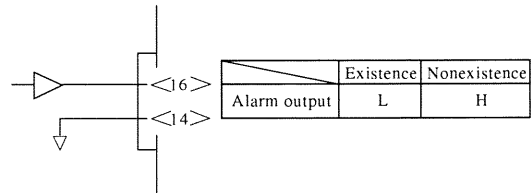


Fig. 4.4-10

- When the alarm is reset after Detection of overvoltage, Detection of overheating, Detection of fuse blow-out or Detection of alarm input appears two times or more continuously, the PSET value is at 0.0W.

4.4.11 Short Function

The short function, once used, automatically sets the maximum current for CC mode or the minimum resistance for CR mode, and the current is supplied accordingly.

When the load terminal voltage drops below 5 V, the short signal output terminal of the external control connector is turned on. This output terminal forms a relay contact and, therefore, drives the external large-current relay to short-circuit the load terminal, as shown below. Since the operating voltage of the load unit is not less than 5 V, the short signal output is used to implement a current limit dropping characteristic test on regulated DC power supplies under 5 V.

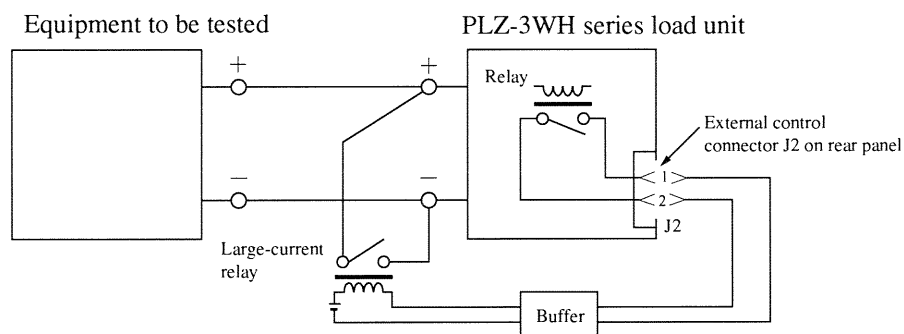


Fig. 4.4-11

NOTE

- To drive the large-current relay, be sure to use a buffer.
- For contacts 1 and 2 in the figure above, the maximum switching current is 500 mA and the voltage rating is 60 VDC.

● Short function operating procedure

Based on the example conditions given below, this subsection explains how to use the short function. In this example, the ISET value has been set to 5.00 A and the [LOAD] switch is turned on to supply a voltage of 20 V and a current of 5 A in CC mode.

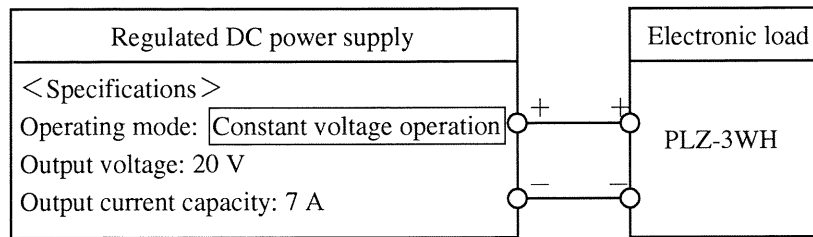
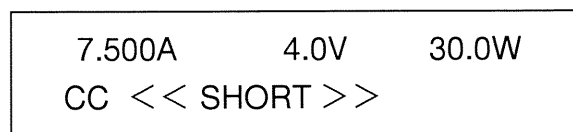


Fig. 4.4-12

- (1) With the load turned on, press the [SHIFT] + [SW] (SHORT) keys. “<<SHORT>>” appears in the lower field of the display and the short function is executed.



In this example, the upper field of the display shows that the current limit of the regulated DC power supply is working at point A (expressed by 7.500 A and 4.0 V, as shown below) on the drooping characteristic curve. The ISET value is set to 7.500 A.

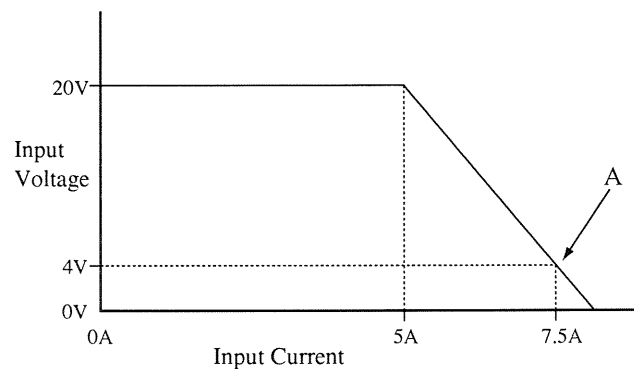
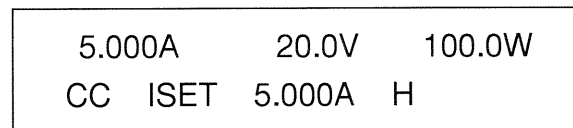


Fig. 4.4-13

- (2) To cancel the short function, press the [SHIFT] + [SW] (SHORT) keys. The display returns to its previous, pre-function status.



The value on the upper left of the display is decreased and the ISET value is changed to 5.000 A. The short function can be executed repeatedly by using the [SHIFT] + [SW] (SHORT) keys.

4.5 Sequence Operation

The sequence operation automatically controls the current in an arbitrary waveform according to the time-dependent variation of certain predetermined mode settings (such as the ISET, RSET, VSET, and PSET values).

On the PLZ-3WH series electronic load unit, the sequence operation can be programmed, saved to the built-in backup memories, and recalled for later execution.

NOTE

In the sequence operation, you can change only one operation mode setting (e.g., an ISET value for CC mode).

● Example of sequence operation

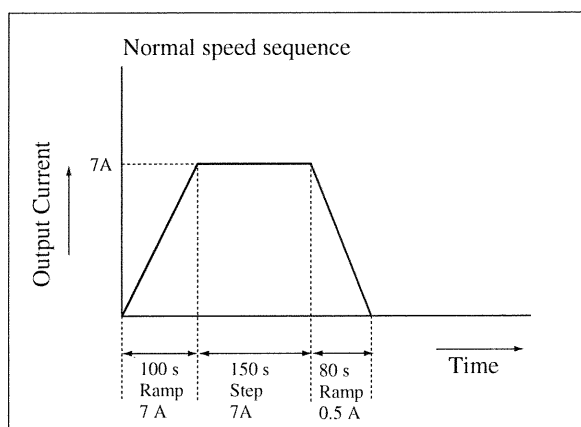


Fig. 4.5-1

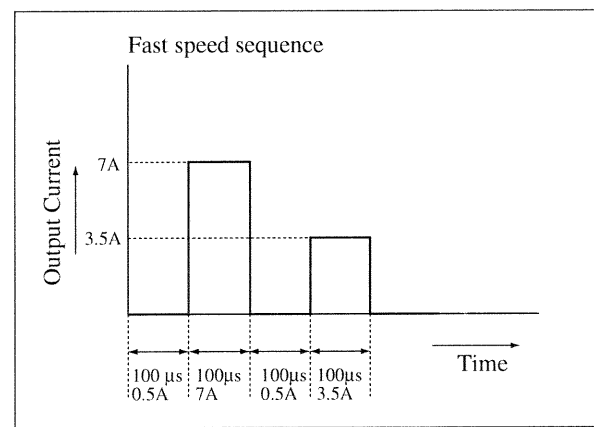


Fig. 4.5-2

4.5.1 Description of Sequence

(a) Type of sequence operation

● Outline

The sequence operation is classified into six sequence modes according to execution speed and operating mode.

Normal speed sequence

CC sequence (NI mode)

CR sequence (NR mode)

CV sequence (NV mode)

CP sequence (NP mode)

Fast speed sequence

CC sequence (FI mode)

CR sequence (FR mode)

These sequence modes covers the following operations.

NI mode : Executes the sequence for mainly the ISET value at normal speeds.

NR mode: Executes the sequence for mainly the RSET value at normal speeds.

NV mode: Executes the sequence for mainly the VSET value at normal speeds.

NP mode : Executes the sequence for mainly the PSET value at normal speeds.

FI mode : Executes the sequence for mainly the ISET value at fast speeds.

FR mode : Executes the sequence for mainly the RSET value at fast speeds.

For set values other than the mode settings that will be subject to sequence operation, the values immediately before execution of the sequence operation are maintained. For example, when you want to execute a sequence operation for the ISET value in NI mode, the PSET and VSET values from immediately before execution of the sequence operation are maintained.

● **Comparison of normal-speed and fast-speed sequences**

The normal-speed and fast-speed sequences differ in terms of operating speed (execution time), step setup items, maximum number of steps, existence/nonexistence of pause function, and existence/nonexistence of a trigger-induced pause reset function. See the table below for details.

Table 4.5-1

	Normal speed sequence	Fast speed sequence
Step setup item	ISET value (NI mode) RSET value (NR mode) VSET value (NV mode) PSET value (NP mode) Trigger output Load on/off Short function setup Step or ramp transition specification Pause function	ISET value (FI mode) RSET value (FR mode) Trigger output
Step execution time	The time can be set for each step. However, the range is fixed for every sequence. 1. Millisecond (ms): 1 ms to 9999 ms 2. Second (s): 1 s to 999.9 s 3. Minute (min and s): 1 s to 999 min 59 s 4. Hour (h and min): 1 min to 999 h 59 min	The step execution time is set for every sequence. Millisecond (ms): 0.1 ms to 100 ms
Pause function	Available	None
Pause reset by trigger input	Resettable	Not resettable
Max number of steps	256 (*1)	1024 (*1)
No. of loops (*2)	1 to 9998, and infinite (9999 should be specified)	1 to 9998, and infinite (9999 should be specified)
No. of programs	16	16
No. of sequences	8	8

*1) Maximum of total number of steps in entire program. For example, if 255 steps are contained in one program used in the normal speed sequence, you can use another program having one step.

*2) Number of program iterations.

When the execution time of one step is shorter than the set TrTf in NI or FI mode, the actual current might not reach the value set in the program.

At the fast speed sequence operation mode when two programs of one step or two steps chained each other are executed at high speed, normal processing may not be done by the occurrence of a reception error for a message through RS-232C. Change programming of the sequence or control the Electronic Load via GPIB.

When the execution time of one step in the NR or FR modes is shorter than 200 μs, which represents both the current rise time and fall time in CR mode, the actual current might not reach the value set in the program.

When you move from the step having 0 A to the next step, a current may rise after a delay of several hundred microseconds and consequently, no current actually flows during several of the 0 A steps. In such an event, setting the 0 A step to about 1 % of the rated current reduces the delay in current rise.

(b) Step, program and sequence

● Step

A “step” is the most basic unit of the sequence operation, and the sequence is executed from the first step. The items listed in Table 4.5-1 are set for each step. In a normal-speed sequence, the step execution time and pause function can be set for each step.

● Program

A “program” is a basic pattern used to execute the sequence operation. One program is a set of steps, and up to 256 steps can be assigned to up to 16 programs for a normal-speed sequence; for a fast-speed sequence, up to 1024 steps can be assigned to up to 16 programs. Each program can be executed independently.

● Sequence

A “sequence” administers the program execution. Any program you want to execute should be specified to a single sequence. The following items are to be specified.

- Program number
- Number of loops (number of specified program iterations)
- Step execution time (step time width)
- Chain sequence (sequence to be executed next)
- End program (end of sequence)

(c) Sequence file

Up to eight sequences can be saved to one file. Moreover, up to one sequence can be saved to the built-in backup memories. One sequence file is constructed as illustrated below.

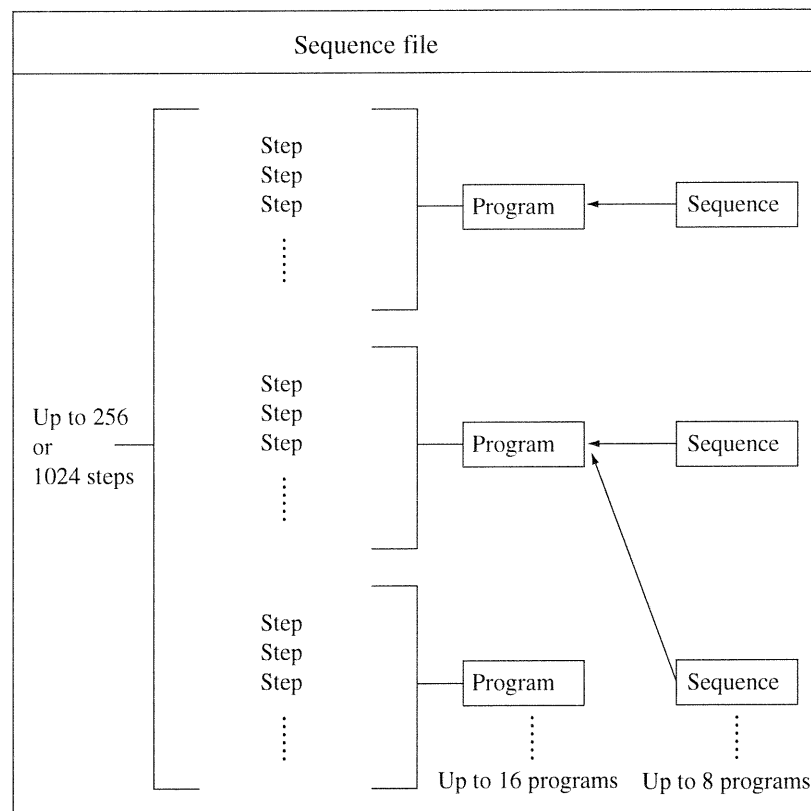


Fig. 4.5-4

You determine whether a normal-speed or fast-speed sequence will be executed for every sequence file, using a sequence operation menu, while a new sequence is being created. (See Sections 4.5.2, “Outline of Sequence Operation Setup” and onward.)

(d) Sequence execution format

In addition to operating mode parameters (such as ISET value), the following items can be set for each step of the sequence operation. (See Table 4.5-1.)

- Output transition (step or ramp)
- Trigger output
- Pause and pause reset by trigger input
- Load on/off
- Short function

The following examples show how to execute a sequence when the output transition, trigger output, pause, and pause reset by trigger input are set.

● **Output transition (the ramp transition is observed only on the normal-speed sequence mode)**

In a step transition, the output changes step by step (Fig. 4.5-5).

In a ramp transition, the output changes in a more sloped manner (Fig. 4.5-6).

Example: Step transition (1 s, 10 A)

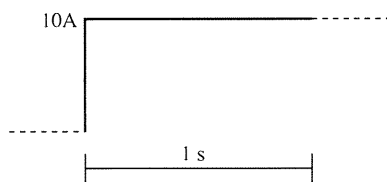


Fig. 4.5-5

Example: Ramp transition (1s, 10 A)

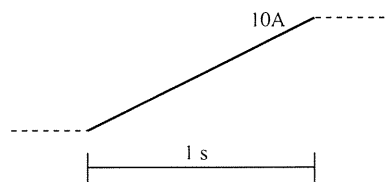


Fig. 4.5-6

● **Trigger output**

When trigger output has been specified, a trigger signal is output from the TRIG OUT terminal on the subpanel during a change of program step (Fig. 4.5-7).

Example: A trigger is set to the step n+1.

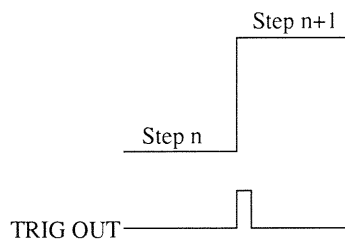


Fig. 4.5-7

● **Pause and pause reset by trigger input (for normal-speed sequence mode only)**

When you press the [PAUSE] key on the subpanel, the sequence operation is paused. After a trigger signal is input from the TRIG IN terminal of the external control connector or the [PAUSE] key is depressed again, the sequence operation is resumed.

Example of pause by program and pause reset by trigger input

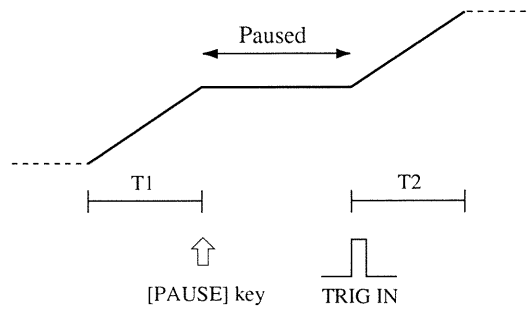


Fig. 4.5-8

Example of pause and pause reset by [PAUSE] key

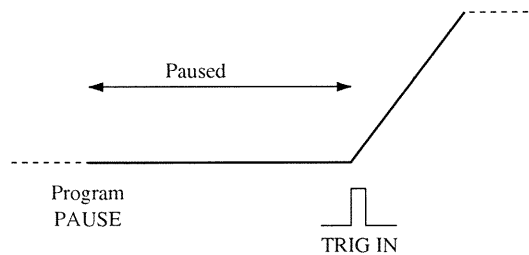


Fig. 4.5-9

NOTE

For electrical features of the TRIG IN terminal, see Section 7.1, "Electrical Specifications".

● Example of normal-speed sequence

The figure below shows an example involving the execution of step, program, and sequence in normal-speed mode. In this example, after sequence 1 is executed, subsequent sequences are executed as illustrated below.

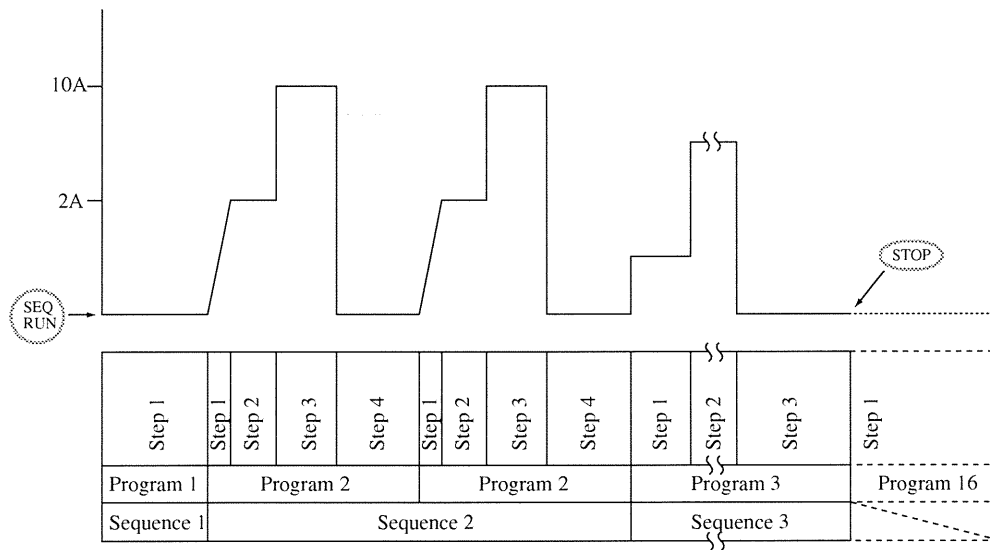


Fig. 4.5-10

- The program 1 is executed once in sequence 1 and the process enters into sequence 2 sequentially.
- The program 2 is executed twice in sequence 2 and the process enters into sequence 3 sequentially.
- The program 3 is executed once in sequence 3, and the process enters into step 1 of program 16 (end program) and comes to an end.

NOTE

The following notes relate to execution of the normal-speed sequence.

- You can arbitrarily specify the program (and its associated sequence) which should be executed first.
- The sequence to be executed cannot be chained to a sequence stored to another sequence file.
- Since the status of the program completion is specified to the end program, only step 1 of the specified program is executed. Therefore, the pause and time data are invalid.
- It takes several milliseconds to several tens of milliseconds to shift to the end program.
- If a chain is specified in the sequence in which the end program is contained, the operation is shifted to that chain sequence without execution of the end program.
- When the sequence is forcibly stopped, for example, by the [STOP] key, step 1 of the end program in the current sequence number is executed. If the end program has not been specified, the sequence ends at the step being executed when the stop command is issued. When the end program has not been specified, "E**" appears on the display.

Note on execution of fast-speed sequence

- If a chain is specified in the sequence, the execution time of the last step might not be equal to the set time.

4.5.2 Outline of Sequence Operation Setup

To set the sequence operation, sequence file management is required, along with creation and editing of sequence parameters. For information on this setup procedure, see Section 4.5.3, “Sequence Operation Setup Procedure”.

● Sequence operation setup menu

The menu used to set the sequence operation has the following contents.

Sequence Menu

- | | |
|------------------|--|
| 1: Edit | Edit Menu |
| 1: Edit Program | Adds, inserts, changes, and deletes programs of the sequence execution memory. |
| 2: Edit Sequence | Creates and edits parameters for the sequence execution memory. |
| 3: New | Initializes the sequence execution memory. |
| 2: Run | Execution Menu |
| | Executes the sequence execution memory. |

● Sequence operation scheme

The following illustration shows a schematic figure of the sequence operation. For the setup procedure, see Section 4.5.3, “Sequence Operation Setup Procedure”.

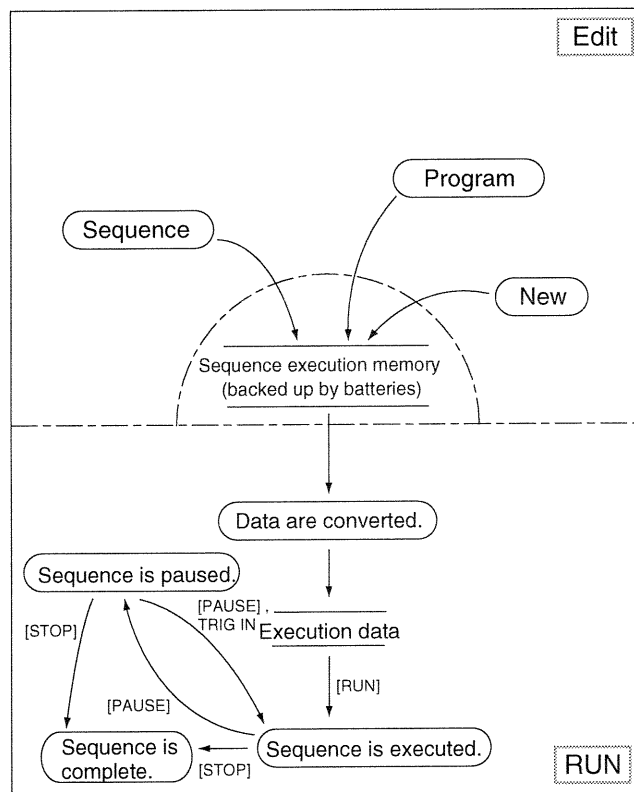


Fig. 4.5-11

4.5.3 Sequence Operation Setup Procedure

Before the sequence operation is executed, we recommend that you copy the “Coding Sheet” attached to Appendix 2 and enter the necessary sequence operation parameters on it. The coding example also shown in Appendix 2 is based on the sequence explained below. In this explanation, the power supply is 5 V and 20 A.

Paragraphs (a) and (b) show the sequence-creating procedures for this coding example.

(a) Creating new sequence execution memory

To execute a sequence operation, you must first create a sequence execution memory. Up to eight sequences can be created in one memory as long as these sequences have the same sequence mode. For information on how to manage the already created sequence execution memory, refer to paragraph (c) below, “Saving, loading, and deleting the file.”

● Setting the sequence mode and initializing the sequence execution memory (example)

This example explains how to select the sequence mode and step execution time range and initialize the sequence execution memory, using the menu.

NOTE

Note that once the sequence execution memory is initialized, all the contents saved to the four sequence files are erased. If these contents are indispensable, save them before the initialization. For information on the saving procedure, see paragraph (c) “Managing the sequence file”.

(1) Press the [SEQ] key on the subpanel to display the Sequence Menu. Using the jog control or [▷] and [◁] keys, select the menu item, “1: Edit”. (In this menu only, you can select a menu item using the jog control.)

```
> 1: Edit
    2: Run
```

(2) Press the [ENTER] key to determine the selection. A submenu appears. Using the jog control or [▷] and [◁] keys, select the menu item, “3: New”.

```
    2: Edit Sequence
    > 3: New
```

(3) Press the [ENTER] key to determine the selection. A submenu appears to confirm that you want to initialize the sequence execution memory. To halt at this point, press the [ESC] key.

```
Create New Sequence
    Sure?
```

(4) After you press the [ENTER] key to affirm that you want to initialize the sequence execution memory, a setup menu appears. Its upper field shows the sequence mode and its lower field, the step execution time range.

```
Mode —> NR
    Unit : msec
```

(5) First, using the jog control, select the “NI” mode (the modes appear on the display cyclically). Next, using the [▷] and [◁] keys, move “->” on the display to “Unit” in the lower field, and select the time range using the jog control. (For information on the time range, see Table 4.5.1.)

```
Mode : NI
    Unit —> msec
```


(6) Press the [ENTER] key to start the initialization (note: the program currently saved to the sequence execution memory is erased). To cancel the initialization, press the [ESC] key. The message “Completed” will appear on the display for about 1 second when the process is executed.

Completed

(7) After the process is successfully completed, the display returns to the submenu.

2: Edit Sequence
> 3: New

(b) Editing the program and sequence

After initializing the sequence execution memory, create a program and edit the sequence.

● Creating a program (example)

This example explains how to specify step 1 as an area of program 1, and set necessary items such as program transitions, ISET values, and execution times according the coding example shown in Appendix 2. Set these parameters to programs 2, 3 and 16 according to the coding example as well.

Specifying the program area:

(1) Open the Edit Menu from the Sequence Menu, and select “1: Edit Program” then press the [ENTER] key. Now, you can specify the program number on the display.

Program:01 :NI
000 Step [T000]

The upper fields shows the program number and sequence mode, the bottom left of the display shows the number of steps contained in the program, and the bottom right of the display shows the total number of steps in all programs.

(2) Select the program number you want to create using the jog control, and press the [ENTER] key. In this example, since the program area is not yet ensured, the message shown at right is observed.

N001
End of step

(3) Pressing the [ENTER] key again displays the menu one hierarchy below the Edit Menu. This menu has the following contents.

N001
> 1: Modify

“1: Modify”: Changes parameters for each program step.

“2: Insert”: Adds the program area (number of steps).

“3: Delete”: Deletes the program area (number of steps).

Since you should create and edit a new program, “2: Insert” must be selected to ensure the program area.

- (4) Select “2: Insert” with the jog control or [▷] and [◁] keys, and press the [ENTER] key. The system prompts you to enter the necessary number of steps and the cursor blinks on the value.
- (5) Select the necessary number of steps with the jog control (select “1” in this example), and press the [ENTER] key. The message “Completed” appears on the display for about 1 second. After the process is successfully completed, the display returns to the menu. Go to the next setup operation.

```
Insert:001
How many steps? 1
```

```
N001 S 0.00A
> 2: Insert
```

Setting transition, ISET value, and execution time:

- (6) Using the jog control or [▷] and [◁] keys, select “1: Modify”.
- (7) Pressing the [ENTER] key displays the program edit field so that you can set the step parameters.

```
N001 S 0.00A
> 1: Modify
```

```
N001 S 0.00A
1ms .L..
```

Before moving to the edit process, you should learn the display contents and their meanings.

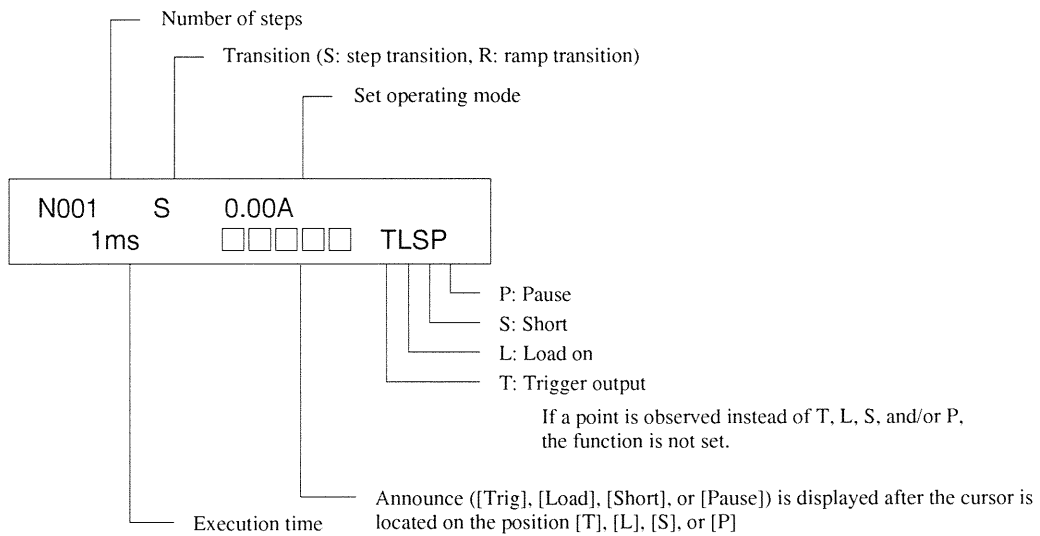


Fig. 4.5-12

NOTE

In the fast-speed sequence mode, only T (trigger output) is observed in the lower field.

The step number is increased with the [SHIFT] + [▷] (△) keys and decreased with the [SHIFT] + [◁] (▽) keys. By changing the step number, you can check each setting. Set items other than the step number (P, S, L, and T) are selected with the [▷] and [◁] keys. The cursor blinks on the selected item. Using the jog control, enter the set value. The edit procedure is explained from step (8) below.

(8) Move the cursor to “0.00 A” with the [▷] key, and modify it to “0.50A” with the jog control.

```
N001 S 0.50 A
      1ms                • L • •
```

(9) Move the cursor to “1 ms” with the [▷] key and modify it to “50 ms” with the jog control. Now, program 1 is set as specified in the coding example. Move to the next operation.

```
N001 S 0.00 A
      50 ms              • L • •
```

Setting programs 2, 3, and 16:

(10) Press the [ESC] key three times to return to the program-number entry menu of step (1) above.

```
Program: 01                :NI
      001 Step [T001]
```

(11) Conduct steps (1) through (9) to create step 01 of program 2.

```
N001 R 10.00 A
      10 ms              TL • •
```

(12) Using the [SHIFT] + [▷] (△) keys, go to step 02 of program 2 and create it.

```
N002 S 10.00 A
      20 ms              • L • •
```

To check or correct the previous step, return to the step with the [SHIFT] + [◁] (▽) keys.

(13) Using the [SHIFT] + [▷] (△) keys, go to step 03 of program 2 and create it.

```
N003 S 20.00 A
      30 ms              • L • •
```

(14) Using the [SHIFT] + [▷] (△) keys, go to step 04 of program 2 and create it.

```
N004 S 0.50 A
      40 ms              • L • •
```

(15) Press the [ESC] key three times to return to the program-number entry menu of step (1) above, and conduct steps (1) through (9) to create step 01 of program 3.

```
N001 S 5.00 A
      30 ms              • L • •
```

(16) Using the [SHIFT] + [▷] (△) keys, go to step 02 of program 3 and create it.

```
N002 S 15.00 A
      8000 ms           • L • •
```

(17) Using the [SHIFT] + [▷] (△) keys, go to step 03 of program 3 and create it.

```
N003 S 0.50A
      50 ms                • L • •
```

(18) Press the [ESC] key three times to return to the program-number entry menu of step (1) above, and conduct steps (1) through (9) to create step 01 of program 16.

```
N001 S 0.50A
      1 ms                • • • •
```

(19) Press the [ESC] key five times to return to the first Sequence Menu.

```
> 1: Edit
   2: Run
```

● **Confirming, changing, deleting, and adding steps**

This example explains how to check the program and step contents, delete steps from the program, and add steps to the program.

Confirming the program and step contents:

(1) Select “1: Edit Program” from the Edit Menu and press the [ENTER] key.

```
Program: 01                :NI
      001 Step [T009]
```

(2) Specify the program number in which the target step is contained, using the jog control, and press the [ENTER] key. This allows you to check the contents of the program. When the step number is specified with the jog control or [▷] and [◁] keys, you can check the contents of the step.

```
N001 S 0.50A
      50ms                • • • •
```

(3) Pressing the [ENTER] key displays the menu one hierarchy below the Edit Menu. After you select “1: Modify” and press the [ENTER] key, the step contents can be edited. (You can edit the step contents using the same operating steps as in the edit procedure, beginning from step (8).)

```
N001 R 10.00A
      > 1: Modify
```

Deleting steps:

(1) Select “3: Delete” from the Edit Menu with the jog control or arrow keys and press the [ENTER] key.

```
Delete: 001
      How many Steps?      1
```

The number on the right of “Delete” shows the first number of the steps you want to delete. The step number can be changed with the [SHIFT] + [▷] (△) keys or [SHIFT] + [◁] (▽) keys.

The lower field shows the number of steps to be deleted in sequential order, starting from the step number specified in the upper field. Set the number of steps with the jog control.

- (2) Upon completion of setup, press the [ENTER] key.
A “Completed” message appears for about 1 second.

Completed

- (3) After the steps are deleted, the display returns to the Edit Menu.

N001
> 3: Delete

Adding steps:

- (1) Select “2: Insert” from the Edit Menu with the jog control or [▷] and [◁] keys, and press the [ENTER] key.

Insert: 001
How many Steps? 1

The number on the right of “Insert” shows the step number at which you want to insert additional steps. The step number can be changed with the [SHIFT] + [▷] (△) keys or [SHIFT] + [◁] (▽) keys.

The lower field shows the number of steps to be inserted before the step number specified in the upper field. Set the number of steps with the jog control.

- (2) Upon completion of setup, press the [ENTER] key.
A “Completed” message appears for about 1 second.

Completed

- (3) After the steps are inserted, the display returns to the Edit Menu. The contents of the inserted steps are undefined.

N001 S 0.00A
> 2: Insert

● Editing the sequence

This paragraph explains how to edit the set items of sequences 1 through 3 according to the coding example of Appendix 2. The execution program number, number of loops (number of program iterations), chain sequence number, and end program number will be edited.

- (1) Select “1: Edit” from the Sequence Menu and press the [ENTER] key to display the Edit Menu. Select “2: Edit Sequence” from the Edit Menu and press the [ENTER] key.

Sequence: 1 :NI
P01, L0000, C*, E**

The number on the right of “Sequence” shows the sequence number. The lower field shows the contents of the sequence. The sequence number can be changed with the jog control or [▷] and [◁] keys.

- (2) Specify the sequence number and press the [ENTER] key. The cursor blinks on the program number indicated on the upper left of the display.

P0 1, L0000,
C*, E**

Before moving to the edit process, you should learn the contents of the display during editing, as shown below.

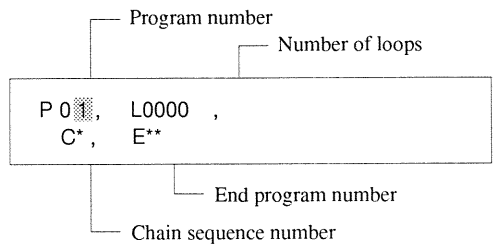


Fig. 4.5-13

NOTE

- When “*” is specified to the chain sequence number, chaining is not carried out.
- When “**” is specified to the end program number, the end program is not executed.

(3) Select the items to be set with [◀] and [▶] keys, and set values to corresponding items with the jog control.

```
P01, L0001,
C2, E16
```

This display shows the sequence 1 edited according to the coding example.

(4) Upon completion of setup, press the [ESC] key to return to step (1). Specify the sequence number to be edited next with the jog control and press the [ENTER] key.

```
P02, L0002,
C3, E16
```

The upper screen shows the result of the edit for sequence 2 and the lower screen shows the result for sequence 3.

```
P03, L0001,
C*, E16
```

(5) To exit editing the sequence, press the [ESC] key twice. The display returns to the Edit Menu.

```
1: Edit Program
> 2: Edit Sequence
```

(c) Running the program and sequence**● Running the program**

This paragraph explains how to execute the specified program once.

- (1) Select “1: Edit” from the Sequence Menu and press the [ENTER] key to display the Edit Menu. Select “1: Edit Program” from the Edit Menu and press the [ENTER] key.

```
Program: 03                               :NI
      003 Step [T009]
```

Using the jog control or [◀] and [▶] keys, specify the program number you want to execute. In this example, program 3 is specified.

- (2) Press the [RUN] key. The program execution starts. The screen on the right shows that the program is being executed.

```
15.00A  5.0V  75.0W
CC S3, P03, L0000, 0002
```

● Running the sequence

This paragraph explains how to execute the specified sequence once.

- (1) Select “2: Run” from the Sequence Menu and press the [ENTER] key. The sequence appears. (When the [RUN] key is depressed without selecting an item from the menu, the sequence appears on the display as well.) Using the jog control or [◀] and [▶] keys, specify the sequence number.

```
Sequence: 1                               :NI
      P01, L0001, C2, E16
```

- (2) Press the [RUN] key. The sequence execution starts. The screen on the right shows that the sequence is being executed. The sequence number (S3) blinks.

```
15.00A  5.0V  75.0W
CC S3, P03, L0000, 0002
```

The figure below shows the contents of the display during execution of this sequence.

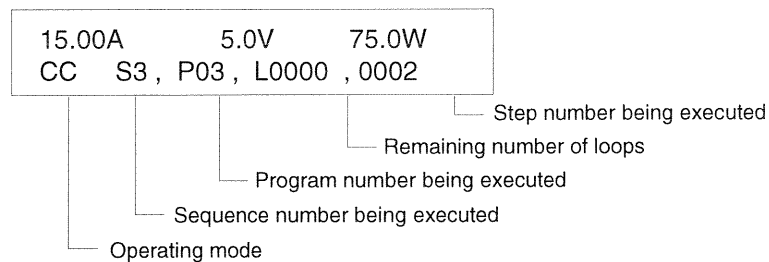


Fig. 4.5-14

NOTE

The sequence number blinks during execution of the sequence and remains on continuously during a pause.

To pause or forcibly stop executing the sequence, use the following procedures. The pause function is not available in the fast-speed sequence mode.

Pause and resumption

(1) When you press the [PAUSE] key during execution of the sequence, the sequence is paused with its contents still appearing on the display, and the sequence number stops blinking.

```
15.00A  5.0V  75.0W  
CC S3, P03, L0000, 0002
```

(2) To resume the paused sequence, press the [PAUSE] key again. The sequence number blinks and the sequence starts.

```
15.00A  5.0V  75.0W  
CC S3, P03, L0000, 0002
```

————— NOTE —————

The [PAUSE] key operation is accompanied by a time delay. After the pause mode is canceled, the remaining part of the paused step is executed and the process enters into the next step.

Forced stop

When you press the [STOP] key during execution of a sequence, the sequence is forcibly stopped and the process ends. The display returns to its original status.

```
Sequence: 1                               :NI  
P01, L0001, C2, E16
```


4.6 External Control

The rear panel of the PLZ-3WH series electronic load unit is equipped with external control connectors J1 and J2 (hereinafter referred to as simply “J1” and “J2”). When other devices are connected to these connectors, you can operate the load unit or check its status externally. Generally, J1 is used as an output terminal and J2 as an input terminal.

J1 and J2 are MIL-type standard 16 P connectors. Since these connectors are equipped with a lock lever, they are both reliable and easy to connect/disconnect. The table and figure below show the functions and terminal arrangement of these connectors.

Table 4.6-1

J1 connector	Terminal number	J2 connector
NC	1	Short output (+)
NC	2	Short output (-)
Trigger signal output (+)	3	Trigger signal input (+)
Trigger signal output (-)	4	Trigger signal input (-), D. COM
Load on/off monitor output (+)	5	Load on/off input (+)
Load on/off monitor output (-)	6	Load on/off input (-)
NC	7	CC/CR voltage control
A.COM	8	A. COM
Slave output	9	Slave input
Current SUM input	10	Current SUM output
NC	11	External resistance control (+)
NC	12	External resistance control (-)
NC	13	CP voltage control
D.COM	14	Alarm output (-)
NC	15	Range select
Alarm input	16	Alarm output (+)

NOTE

The trigger signal output terminals are internally connected to the TRIG OUT terminals on the bottom left of the subpanel.

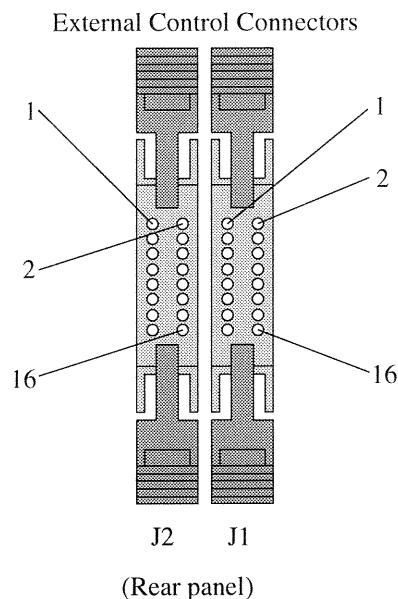


Fig. 4.6-1

To connect with J1 and J2, use the plugs contained in the packaging for your PLZ-3WH series electronic load unit, or use the parts listed below.

Table 4.6-2

Manufacturer	Product	Remarks
OMRON	XG5M-1632 or XG5M-1635 XG5S-0801 (2 ea.)	For discrete wire
OMRON	XG4M-1630 XG4T-1604	For flat cable
KEL	6200-016-601	For flat cable

CAUTION

- For the flat cable, be sure to use some form of strain relief structure.
- To press-fit discrete wires or flat cables, be sure to use a special tool. For details, refer to the instruction manual provided by the relevant cable manufacturer.
- Before connecting or disconnecting the cable, be sure to turn off the [POWER] switch of the load unit.

SW2 and SW3 switches setting

When the external control of CC mode or CR mode is not used, set the [SW2] to the LOCAL position and the [SW3] to the V position.

4.6.1 External Control of CC (Constant Current) Mode

(a) External voltage method

An external voltage from 0 to approx. 10 V is applied to the load unit to flow the input current in proportion to the voltage.

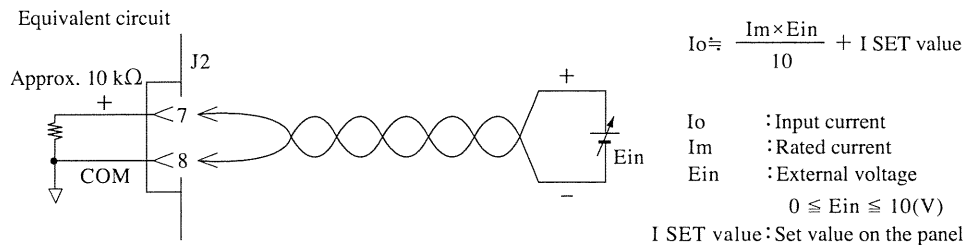


Fig. 4.6-2

● Setup procedure

- (1) Press the [POWER] switch to turn off the load unit.
- (2) Connect the external voltage to J2 terminals 7 and 8 on the rear panel.
- (3) On the rear panel, set the external control setup switch [SW2] to the “REM” position and [SW3] to the “V” position.
- (4) Press the [POWER] switch to turn on the load unit.
- (5) Press the [I SET] key on the front panel to enable the CC mode.
- (6) Using the semifixed resistors [OFS] and [FS] on the rear panel, adjust the current offset and maximum current, respectively.
- (7) Using the [SHIFT] + [STOP] (KEYLOCK) keys, put the load unit into keylock condition.

CAUTION

- Up to ± 11 V can be applied between J2 terminals 7 and 8. If the voltage exceeds this value, the load unit may be damaged. The accuracy cannot be guaranteed when the voltage is at 0 V or below or at 10 V or over.
- The J2 terminal 8 is connected to the negative side of the load terminal inside the load unit. Take care so that this terminal 8 will not contact any of the other terminals.

When the external voltage is used for external control, the input current is a sum of the current proportional to the external voltage and the ISET value set on the load unit panel. However, only the ISET value appears on the display, meaning that the input current is not equal to the ISET value. Therefore, to prevent changing the ISET value mistakenly, put the load unit into keylock condition.

To prevent noise interference, use twisted pair or shielded signal cable. Also, use a stable external voltage to generate less noise.

When the external voltage is used for external control, even the CC mode needs the same terminals as the CR mode. Therefore, always recheck the operating mode.

(b) External resistance method

An external resistance from 0 Ω to approx. 10 kΩ is connected to the load unit to flow the input current in reverse proportion to the resistance.

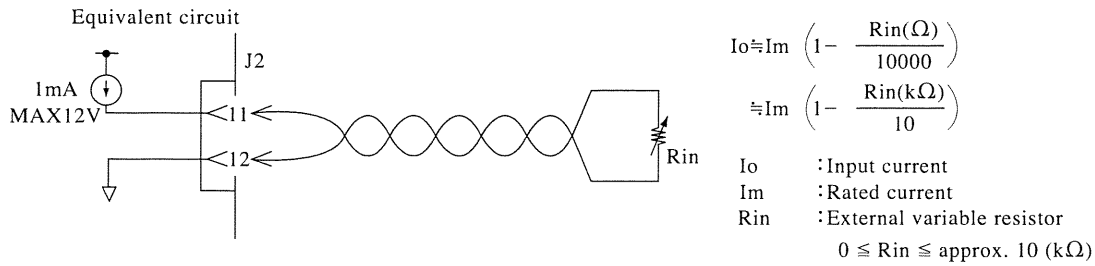


Fig. 4.6-3

● **Setup procedure**

- (1) Check that the [LOAD] switch is turned off, and set the ISET value to the rated current on the front panel.
- (2) Press the [POWER] switch to turn off the load unit.
- (3) Connect the external variable resistor to J2 terminals 11 and 12 on the rear panel, and maximize the resistance.
- (4) On the rear panel, set the setup switch [SW2] to the “LOCAL” position and [SW3] to the “R” position.
- (5) Press the [POWER] switch to turn on the load unit.
- (6) Press the [I SET] key on the front panel to enable the CC mode.
- (7) Using the [SHIFT] + [STOP] (KEYLOCK) keys, put the load unit into keylock condition.

The external variable resistor used should be resistant to temperature and aging, and its residual resistance should not exceed 300 Ω . We recommend use of a wire wound resistor, metal film resistor, or multirotational potentiometer. To prevent noise interference, use twisted pair or shielded signal cable.

If the ISET value is set to any value other than the rated current, the set current range fails to cover the standard value. Note that if the ISET value is set to 0 A, control with external resistance becomes impossible and the rated current is supplied to the load terminal.

When the external resistance is used for external control, even the CC mode needs the same terminals as the CR mode. Therefore, always recheck the operating mode.

When Rin is equal to 10 k Ω, Io is securely 0 A. This may cause a minor offset as shown in the figure below.

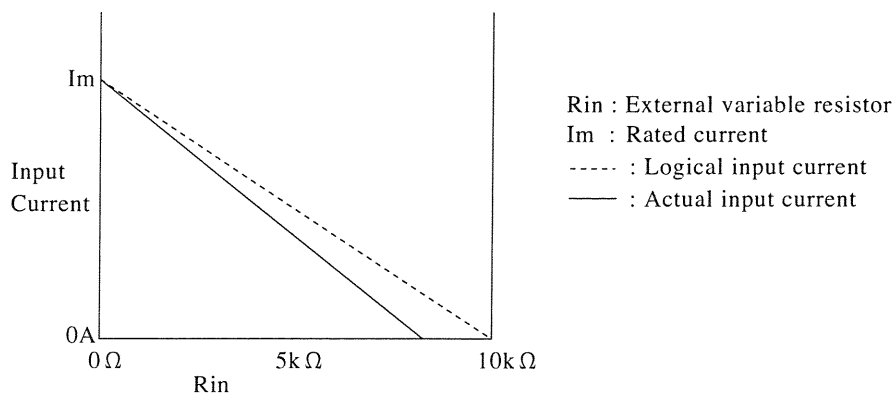


Fig. 4.6-4

4.6.2 External Control of CR (Constant Resistance) Mode

(a) External voltage method

An external voltage from 0 to approx. 10 V is applied to the load unit to change the resistance in proportion to the voltage.

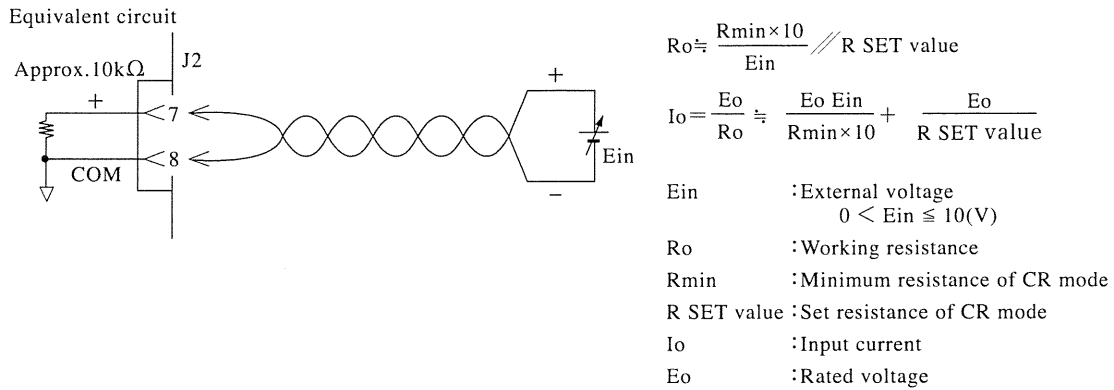


Fig. 4.6-5

● Setup procedure

- (1) Press the [POWER] switch to turn off the load unit.
- (2) Connect the external voltage to J2 terminals 7 and 8 on the rear panel.
- (3) On the rear panel, set the external control setup switch [SW2] to the “REM” position and [SW3] to the “V” position.
- (4) Press the [POWER] switch to turn on the load unit.
- (5) Press the [R SET] key on the front panel to enable the CR mode.
- (6) Set the external voltage to 0 V, and adjust the maximum resistance with the semifixed resistor [OFS] on the rear panel. Then, set the external voltage to 10 V, and adjust the minimum resistance with the semifixed resistor [FS] on the rear panel.
- (7) Using the [SHIFT] + [STOP] (KEYLOCK) keys, put the load unit into keylock condition.

CAUTION

- Up to ±11 V can be applied between J2 terminals 7 and 8. If the voltage exceeds this value, the load unit may be damaged. Unit accuracy cannot be guaranteed when the voltage is at 0 V or below or at 10 V or over.
- The J2 terminal 8 is connected to the negative side of the load terminal inside the load unit. Take care so that this terminal 8 will not contact any of the other terminals.

When the external voltage is used for external control, the working resistance is a sum of the resistance proportional to the external voltage and the RSET value set on the load unit panel. However, only the RSET value appears on the display, meaning that the working resistance is not equal to the RSET value. Therefore, to prevent changing the RSET value mistakenly, put the load unit into keylock condition.

To prevent noise interference, use twisted pair or shielded signal cable. Also, use stable external voltage to generate less noise.

When the external voltage is used for external control, even the CR mode needs the same terminals as the CC mode. Therefore, always recheck the operating mode.

(b) External resistance method

The external resistance from 0 Ω to approx. 10 kΩ is connected to the load unit to change the resistance in reverse proportion to the external resistance.

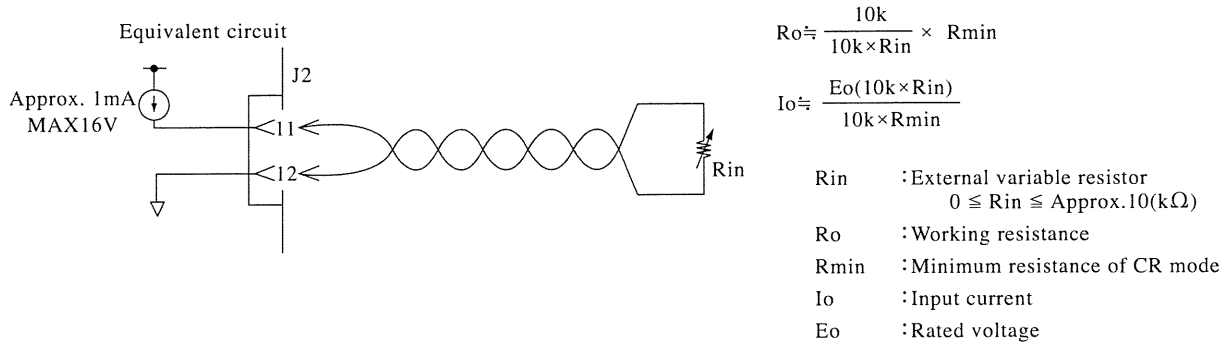


Fig. 4.6-6

● Setup procedure

- (1) Check that the [LOAD] switch is turned off, and set the RSET value to the minimum resistance on the front panel.
- (2) Press the [POWER] switch to turn off the load unit.
- (3) Connect the external variable resistor to J2 terminals 11 and 12 on the rear panel, and maximize the resistance.
- (4) On the rear panel, set the setup switch [SW2] to the “LOCAL” position and [SW3] to the “R” position.
- (5) Press the [POWER] switch to turn on the load unit.
- (6) Press the [R SET] key on the front panel to enable the CR mode.
- (7) Using the [SHIFT] + [STOP] (KEYLOCK) keys, put the load unit into keylock condition.

The external variable resistor used should be resistant to temperatures and aging, and its residual resistance should not exceed 300 Ω. We recommend use of a wire wound resistor, metal film resistor, or multirotational potentiometer. To prevent noise interference, use twisted pair or shielded signal cable.

If the RSET value is set to any value other than the minimum resistance, the working resistance range fails to cover the standard value. If the RSET value is set to the maximum resistance, control with external resistance becomes impossible and the working resistance is minimized.

When the external voltage is used for external control, even the CR mode needs the same terminals as the CC mode. Therefore, always recheck the operating mode.

When Rin is equal to 10 kΩ, Io is securely 0 A. This may cause a minor offset as shown in the figure below.

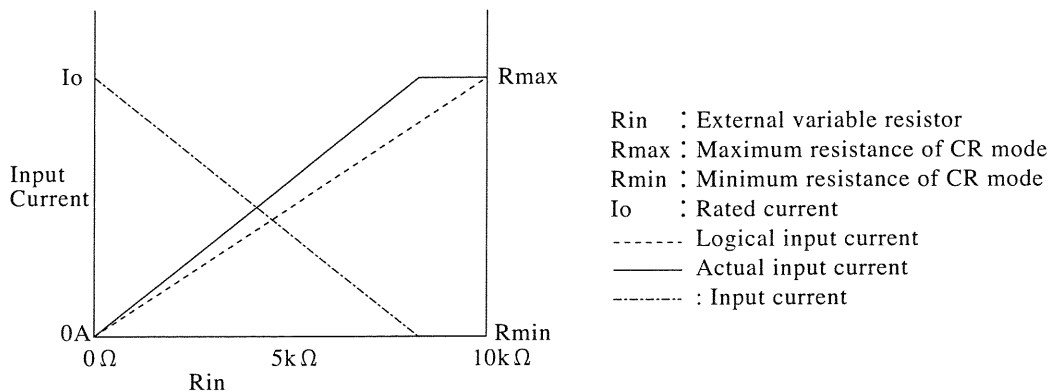


Fig. 4.6-7

4.6.3 External Control of CP (Constant Power) Mode

An external voltage from approx. 0 to 10 V is applied to the load unit to change the power.

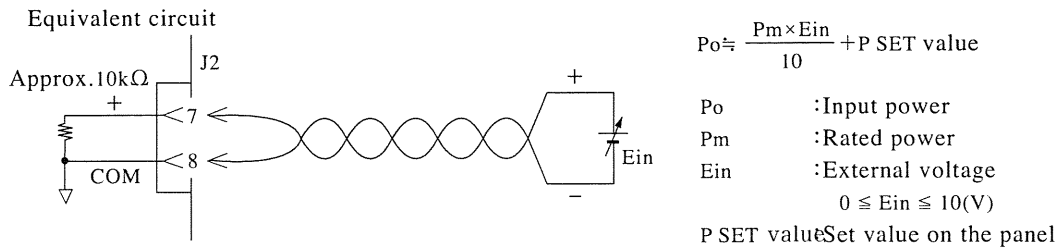


Fig. 4.6-8

● Setup procedure

- (1) Press the [POWER] switch to turn off the load unit.
- (2) Connect the external voltage to J2 terminals 8 and 13 on the rear panel.
- (3) Press the [POWER] switch to turn on the load unit.
- (4) Press the [P SET] key on the front panel to set the PSET value.
- (5) Using the [SHIFT] + [STOP] (KEYLOCK) keys, put the load unit into keylock condition.

CAUTION

- Up to ± 11 V can be applied between J2 terminals 8 and 13. If the voltage exceeds this value, the load unit may be damaged. Unit accuracy cannot be guaranteed when the voltage is at 0 V or below or at 10 V or over.
- The J2 terminal 8 is connected to the negative side of the load terminal inside the load unit. Take care so that this terminal 8 will not contact any of the other terminals.

When the external voltage is used for external control, the working power is a sum of the power proportional to the external voltage and the PSET value set on the load unit panel. However, only the PSET value appears on the display, meaning that the working power is not equal to the PSET value. Therefore, to prevent changing the PSET value mistakenly, put the load unit into keylock condition.

To prevent noise interference, use twisted pair or shielded signal cable. Also, use a stable external voltage to generate less noise.

4.6.4 External Control of Load on/off

Using the external control connectors, you can control the load on/off externally or check the on/off status. You can also control connected multiple load units simultaneously.

(a) Control with external switch (one load unit)

Connect the external switch to J2 terminals 5 and 6 on the rear panel(Fig. 4.6-9). This controls the load on/off externally. To turn Load-on/off with external switch, turn the electronic load Load-off state with [LOAD] key on the front panel.

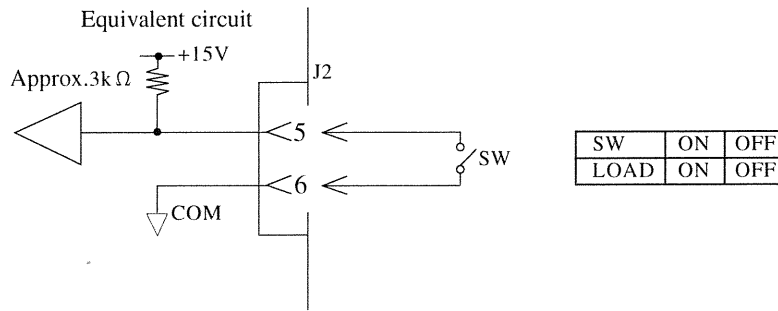


Fig. 4.6-9

NOTE

Load-on state by external switch at operates, when Detection of overvoltage, Detection of overheating, Detection of fuse blow-out or Detection of alarm input, however, load-lamp does not tune off the light.

A current of about 4.5 mA is applied to the external switch (SW) and its release voltage is about +15 V. Be sure to return the current to the J2 terminal 6.

(b) Load on/off monitor output

By monitoring the output signals of J1 terminals 5 and 6 on the rear panel, you can check the load on/off status of the load unit.

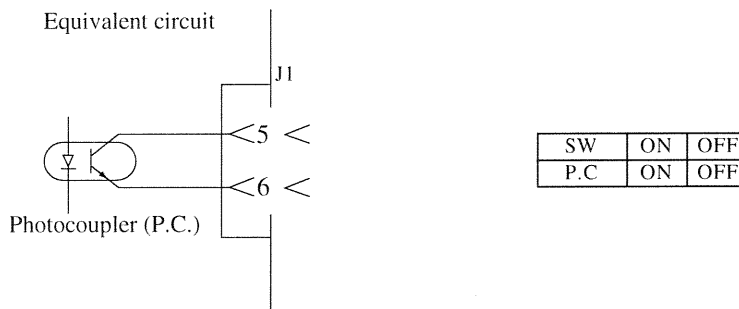


Fig. 4.6-10

NOTE

Load-on state by external switch at operates, when Detection of overvoltage, Detection of overheating, Detection of fuse blow-out or Detection of alarm input, however, Load-on/off monitor output keep on.

Since these terminals are equipped with open-collector-type photocouplers, they are isolated from other terminals. The maximum rating of the photocoupler sensor is as follows:

Vceo: 30 V, Ic: 5 mA, Pc: 150 mW

(c) Control with external switch (multiple load units)

After several load units are connected as illustrated below, you can simultaneously control the load on/off for all the units from outside. J1 terminals 5 and 6 are isolated from the load terminal, which means that the unit will operate even if a potential difference occurs on the negative load terminal of each load unit.

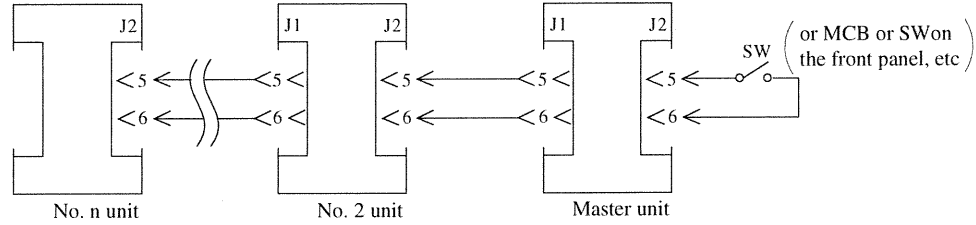


Fig. 4.6-11

4.6.5 External Control of Range Select

Using the external control connectors, you can control the range select of the CC or CR mode externally. However, to select the range externally, the range set from the panel must be H.

Connect the external switch to J2 terminals 4 and 15 of the load unit rear panel (see the figure below).

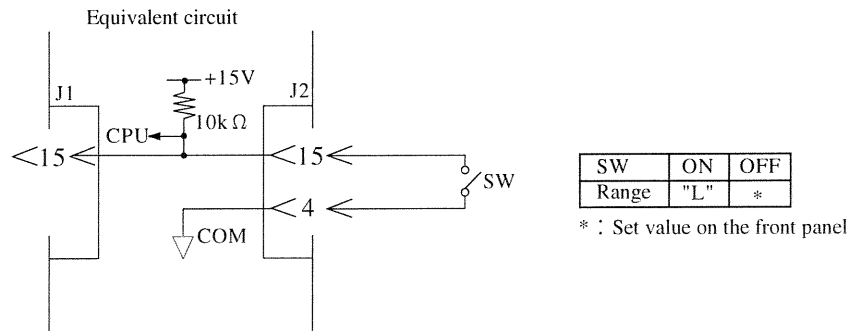


Fig. 4.6-12

NOTE

The external switch (SW) takes precedence over range selection from the operation panel. Therefore, when this external switch is turned on and the range L is selected, the range cannot be changed to H from the panel. A current of about 0.5 mA is supplied to the external switch and its release voltage is about +15 V. Be sure to return the current to the J2 terminal 4.

4.6.6 Trigger Signal

The trigger signal can be used as a synchronous signal to observe waveforms generated by the switching operation on the oscilloscope. This signal is also used to remove a pause from the sequence operation.

(a) Trigger signal output

The trigger signal is output from J1 terminals 3 and 4 on the rear panel and the TRIG OUT terminals on the subpanel. (See the figure below.)

The trigger signal is output when:

- the trigger output is specified in the sequence operation,
- a signal is input to the trigger input terminals,
- the “GET” command is input to GPIB, or
- the trigger signal is set to be output by a switching operation.

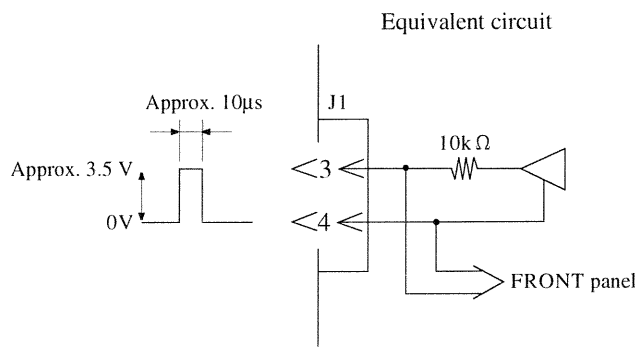


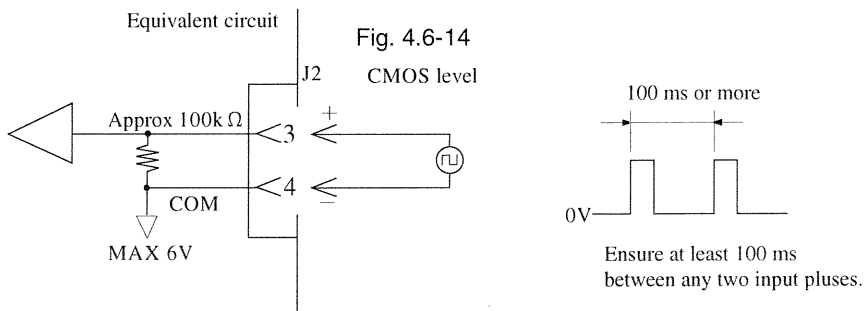
Fig. 4.6-13

NOTE

The trigger signal is characterized by an output voltage of about 3.5 V, pulse width of not less than 5 μs, and output impedance of about 10 kΩ. The trigger output terminals are isolated from any other terminals.

(b) Trigger signal input

The trigger signal is input to J2 terminals 3 and 4 on the rear panel. When the signal voltage, whose maximum allowable voltage is 6 V and pulse width is not less than 20 μs, is input to these terminals, the load unit can be synchronized with another load unit (see the figure below).



NOTE

When the pulse input to the trigger signal input terminals rises, the trigger signal is generated on the trigger signal output terminals. The input terminals are connected to COM via about 100 kΩ resistance, and the maximum allowable voltage is 6 V. The operating threshold level is TTL.

4.7 Parallel Operation

When multiple identical load units are connected and operated in parallel, the current and power capacities can be increased. In parallel operation, one master unit controls multiple slave units. Since the master unit is connected to the slave units with flat cable control lines equipped with a MIL-compliant connector, the system can easily be expanded.

CAUTION

- To run PLZ153WH and PLZ303WH load units in parallel, be sure to use the load terminal on the rear panel.
- Operation in series is not possible.

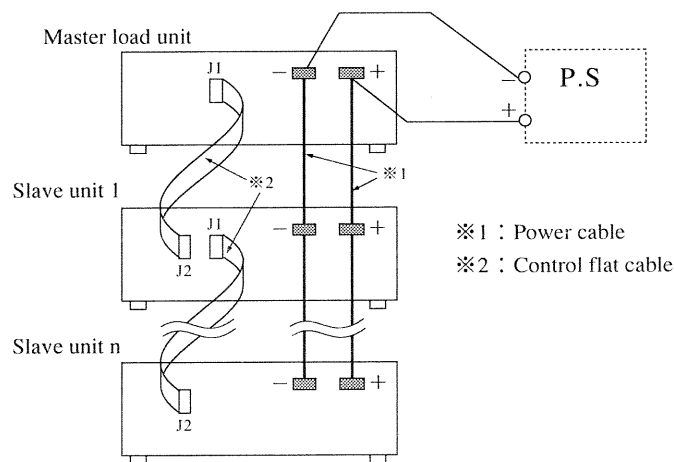


Fig. 4.7-1

● Setup procedure

- (1) Turn off [POWER] switches of all the connected load units.
- (2) Be sure to connect the load terminals [DC INPUT] of the master and slave units (see the figure above).
- (3) Connect J1 of the master unit to J2 of the slave unit 1 using a flat cable. Connect J1 of the slave unit 1 to J2 of the slave unit 2 using a flat cable. Connect J1 of the slave unit 2 to J2 of the slave unit 3 using a flat cable. Repeat the connections until all the load units are connected to each other.
- (4) Set the dip switch [SW1-1] on the rear panel of each slave unit to the “ON” position.
- (5) Call the Configuration Menu using [SHIFT] + [R SET] (CONFIG) keys on the master unit operation panel, and select the menu item, “14: Parallel Ope.” This sets all the load units to be operated in parallel, including the master unit.
- (6) Press the [ESC] key to return the display to its pre-setup status.

NOTE

Although the set ranges for the current, power, and resistance are all increased on the master unit, the pre-setup values still appear on the display. When you carry out parallel operation by a mode except CP mode, be sure to change PSET value of the master unit to the required power value.

Turn on all the [POWER] switches simultaneously, or turn on the [POWER] switch(es) of the slave unit(s) first. An alarm “*ALARM EXT” may appear on the display.

Note that if J1 and J2 are connected incorrectly, the load units may be damaged. Up to five load units can be operated in parallel as long as they are all of identical type. If you want to operate more than five load units in parallel, contact your Kikusi agent.

Cut the connecting load wires and flat cables as short as possible. Select sufficiently thick load wires, taking into consideration the current used. Separate the load wires and flat cables as far as possible to prevent unreliable operations.

After the dip switch [SW1-1] of the slave unit is turned on, "<SLAVE>" appears on the display to show that the system is now in its parallel operating mode. Although the operating mode indicated on the slave unit may differ from that on the master unit, this is not a problem. The current displayed on the slave unit shows its input current and this value may thus deviate from those on the other slave units by several percent.

When the number of units operated in parallel is increased, the set ranges for the current, power, and resistance are all increased on the master unit. The current (power) indicated on the master unit is a sum of all the current (power) for the load units being operated in parallel. Moreover, the current indicated on the master unit may have an error of several percent relative to the total current. (Note: use a procedure explained subsequently to calibrate the ammeter.)

In parallel operation, the input current ripple is increased by a factor approximately equal to the number of parallel units in operation.

When an alarm occurs during parallel operation, the [LOAD] switches for all the units are turned off (except for the overcurrent and reverse-connection detection functions), and "*ALARM EXT" appears on the display. Reset alarms for the other load units connected to J1, first.

To return to individual operation from parallel operation, remove the flat cables and set the number of parallel units to "1". The ISET, RSET, and PSET values set in excess of their ratings are reset to the maximum levels for the relevant mode. (The RSET value is reset to the minimum resistance).

Flat Cable

To connect multiple load units for parallel operation, select a shielded flat cable, and connect the shield to the chassis.

Be sure to use a strain relief structure as shown in the figure at right, and arrange the cable so that terminals P1 and P2 are correctly connected. Determine the distance L depending on the installation condition of the load units (e.g., when two load units are stacked, the minimum L dimension is 20 cm).

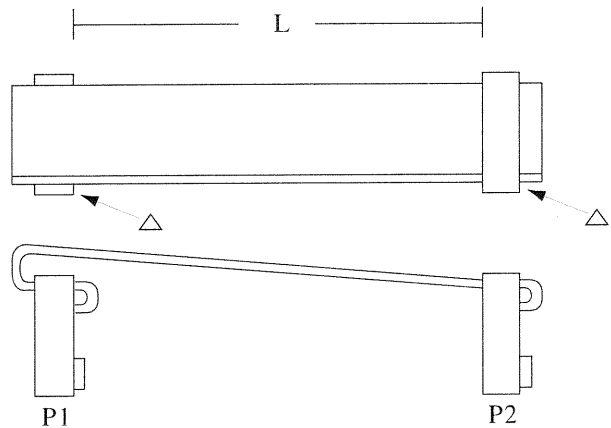


Fig. 4.7-2

When a connector equipped with a strain relief structure is used, minimize the folded area of the flat cables to prevent interference, and lay out the cables so that their folded sections face the same direction, as shown in the figure below.

- Flat cable connector
- KEL connector: 6200-016-601
- OMRON connector: XG4M-1630 or XG4T-1604

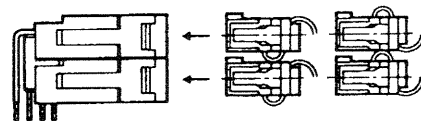


Fig. 4.7-3

Calibration of Ammeter for Parallel Operation

Each ammeter of the load unit is calibrated before shipment from the factory. However, when the ammeters are calibrated with the load units connected in parallel, higher accuracy is obtained.

After installation and connections for parallel operation are complete, provide the below-described calibration for the master unit. For information on preparation, measuring equipment, connection, and entry into calibration mode, see Chapter 6, "Maintenance and Calibration".

- (1) Select the calibration mode, select the ammeter offset calibration item "offsIadSum" from the menu with [▷] and [◁] keys, and press the [LOAD] switch to turn on the load. Apply a voltage to the load terminal so that the voltmeter reads 20.0 V, and use the jog-shuttle to set the ammeter to 0.00 A.

0.00A	20.0V	0.0W
CC offsIadSum		35

- (2) Using [▷] and [◁] keys, select the ammeter maximum calibration item "gainIadSum" from the menu. Press the [LOAD] switch to turn on the load, apply a voltage to the load terminal so that the voltmeter reads 20.0 V, and use the jog-shuttle to set the ammeter to the value listed in the table below.

25.20A	20.0V	126.0W
CC gainIadSum		22539

NOTE

If the maximum calibration is carried out after the offset calibration, the offset may deviate from the calibrated value. Therefore, repeat these two calibrations alternately until the desired level is obtained.

- 3) Press the [ESC] key to escape from the calibration mode.

Per-Model Ammeter Reading at Ammeter Maximum Calibration

Electronic load unit	No. of units operated in parallel			
	Two	Three	Four	Five
PLZ153WH	3.150A	4.725A	6.300A	7.875A
PLZ303WH	6.30A	9.45A	12.60A	15.75A
PLZ603WH	12.60A	18.90A	25.20A	31.50A
PLZ1003WH	21.00A	31.50A	42.00A	52.50A

Ammeter reading at calibration of "gainIadSum"

5

Chapter 5 Remote Control

This chapter describes the operating procedure and programming methods necessary to control the load unit remotely from an external device, such as a PC, by means of the optional interface board.

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5.1 Initial Setup of Interface

This section explains the initial setup of the GPIB, RS-232C, and MCB interfaces.

5.1.1 GPIB Interface (IB11)

(a) Setting the GPIB address

The GPIB address is set to “1” before shipment from the factory. To change this default setting, see Section 4.4.9, “Configuration” of Chapter 4, “Operating Procedure”.

(b) Setting the response message terminator (delimiter)

Select any of the following four response message terminators.

CRLF+EOI, CR+EOI, LF+EOI, EOI

To set the response message terminator, use the TERM command (see Section 5.3.2-(h)). If the response message terminator has been set incorrectly, signal communication between the external controller and interface may be unsuccessful.

NOTE

The response message terminator is set to “CRLF+EOI” before shipment from the factory.

(c) Setting the power-on service request (Power-on SRQ)

For the setup procedure of the power-on service request, see Section 4.4.9, “Configuration” of Chapter 4, “Operating Procedure”.

NOTE

The power-on service request is set to “Disable” before shipment from the factory.

5.1.2 RS-232C Interface (RS11)

(d) Setting the RS-232C protocol

The default settings before shipment from the factory are as follows.

Baud rate: 9600 bps	Stop bit length: 2 bits
Data length: 8 bits	Parity bit: None

For the setup procedure of the RS-232C protocol, see Section 4.4.9, “Configuration” of Chapter 4, “Operating Procedure”.

(e) Setting the response message terminator (delimiter)

Select any of the following four response message terminators.

CRLF, CR, LF, None

To set the response message terminator, use the TERM command (see Section 5.3.2-(h)). If the response message terminator has been set incorrectly, signal communication between the external controller and interface may be unsuccessful.

NOTE

The response message terminator is set to “CRLF” before shipment from the factory.

5.1.3 MCB Interface (MC11S)

Setting the MCB address

To use this interface, the equipment address must be set as follows.

Slave unit: 1 to 15 (Any value can be set. The default is 15.)

Master unit: The address is automatically set and fixed to 0 according to the GPIB or RS-232C board.

For the setup procedure of the MCB address, see Section 4.4.9, “Configuration” of Chapter 4, “Operating Procedure”.

5.2 Programming Format

This section explains general programming formats.

5.2.1 Command

The following commands are sent to the load unit from the GPIB controller or RS-232C terminal.

(a) Program message

This command operates the load unit. The program message consists of an ASCII-coded character string containing a header and data. (For information on the header and data, see Section 5.3.1, "Header and Data".)

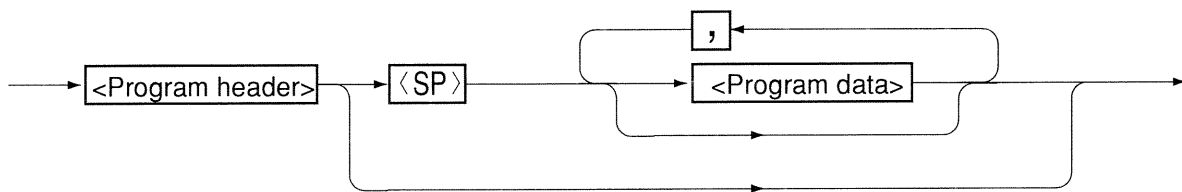


Fig. 5.2-1

(b) Query message

This command requests the information about the load unit. The query message consists of an ASCII-coded character string containing a header with a question mark (?) and data.



Fig. 5.2-2

(c) Compound message

This command consists of multiple program messages and query messages.

The GPIB interface has a unique "hold off" function. When "@" is added to the end of the program or query message, this "hold off" status can be maintained until the message is fully executed.

However, in the event of a program message terminator with only EOI, use "@@".

The hold-off function is peculiar to the GPIB interface board (IB11).

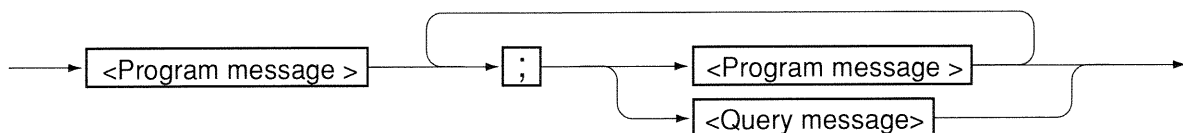


Fig. 5.2-3

5.2.2 Response Message

The response message is information returned to the GPIB controller or RS-232C terminal from the load unit in response to the query message. This response message consists of an ASCII-coded character string containing a header and numerical data. All the characters are in upper case.

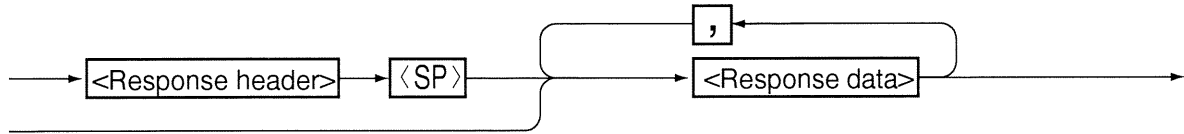


Fig. 5.2-4

5.2.3 Acknowledge Message (RS-232C)

The acknowledge message is a function unique to the RS-232C interface. This message is returned to the RS-232C terminal from the load unit in response to the program message, to inform the terminal that the program message has been fully processed. The acknowledge message consists of an ASCII-coded character string containing only a header.

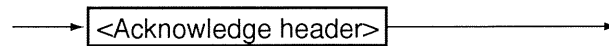


Fig. 5.2-5

The acknowledge message is classified into the following three types.

- “OK” : The process ends normally.
- “ERROR” : A faulty event such as syntax error occurs.
- “TIME OUT” : An MCB address error occurs.

The acknowledge message can be enabled or disabled with the SILENT command (see Section 5.3.2-(j)). The default is “disabled”.

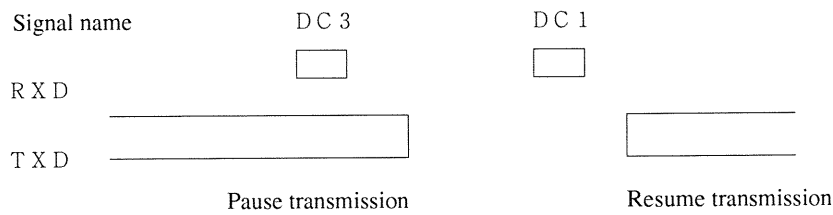
5.2.4 Flow Control (RS-232C)

The flow control is a function unique to the RS-232C interface. This function provides communication with an XON/XOFF flow control. The device control (DC) code is used in this control (see the table below).

Table 5.2-1

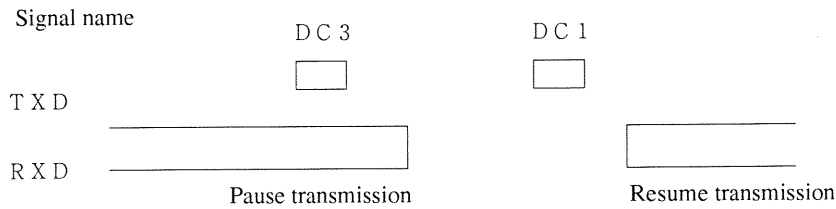
	Function	ISO or EIA code
DC1	Requests the transmission.	11h
DC3	Requests terminating the transmission.	13h

(a) Transmission control from RS-232C terminal to interface



In the above chart, the transmission is paused within three characters upon reception of a DC3.

(b) Transmission control from RS-232C interface to terminal



In the above chart, the transmission is paused within ten characters upon reception of a DC3.

CAUTION

Be sure to control the communication using the flow control method or acknowledge message. In one-way transmission, data may be communicated incorrectly.

5.3 Description of Command

This section explains the commands available. Appendix 4 of this manual lists sample programs in which the commands shown below are described. Use these samples as a reference for your programming.

5.3.1 Header and Data

(a) Header

The header is a keyword for commands and consists of an ASCII-coded character string. While the header is described in upper case in this manual, lower case characters can also be used without any trouble. Do not place other characters such as spaces between characters.

(b) Data

Data is an argument following the header, and a format is defined for each header (see the table below).

Table 5.3-1

Data type	Format
NR1	1 (ON) / 2 (OFF)
NR2	Decimal integer
NR3	Hexadecimal integer
NR4	Real number (see Note)
"string"	Alphanumeric character string (control codes are not permitted). A quotation mark (") must be added before and after the character string.
sp	Space code (20h)
?	"?" character code (3Fh)
,	"," character code (2Ch)

NOTE

Any type of real number, i.e., integer, decimal, or exponential can be used as data (e.g., 8, 1.25, and 2.56E+1, respectively). The following units can be identified.

Voltage : KV, V, MV ("V" in abbreviation form)
 Current : KA, A, MA ("A" in abbreviation form)
 Power : KW, W, MW ("W" in abbreviation form)
 Resistance : KOHM, OHM, MOHM ("OHM" in abbreviation form)
 Time : S, MS, US ("S" in abbreviation form)

5.3.2 Configuration of Commands

(a) Basic command

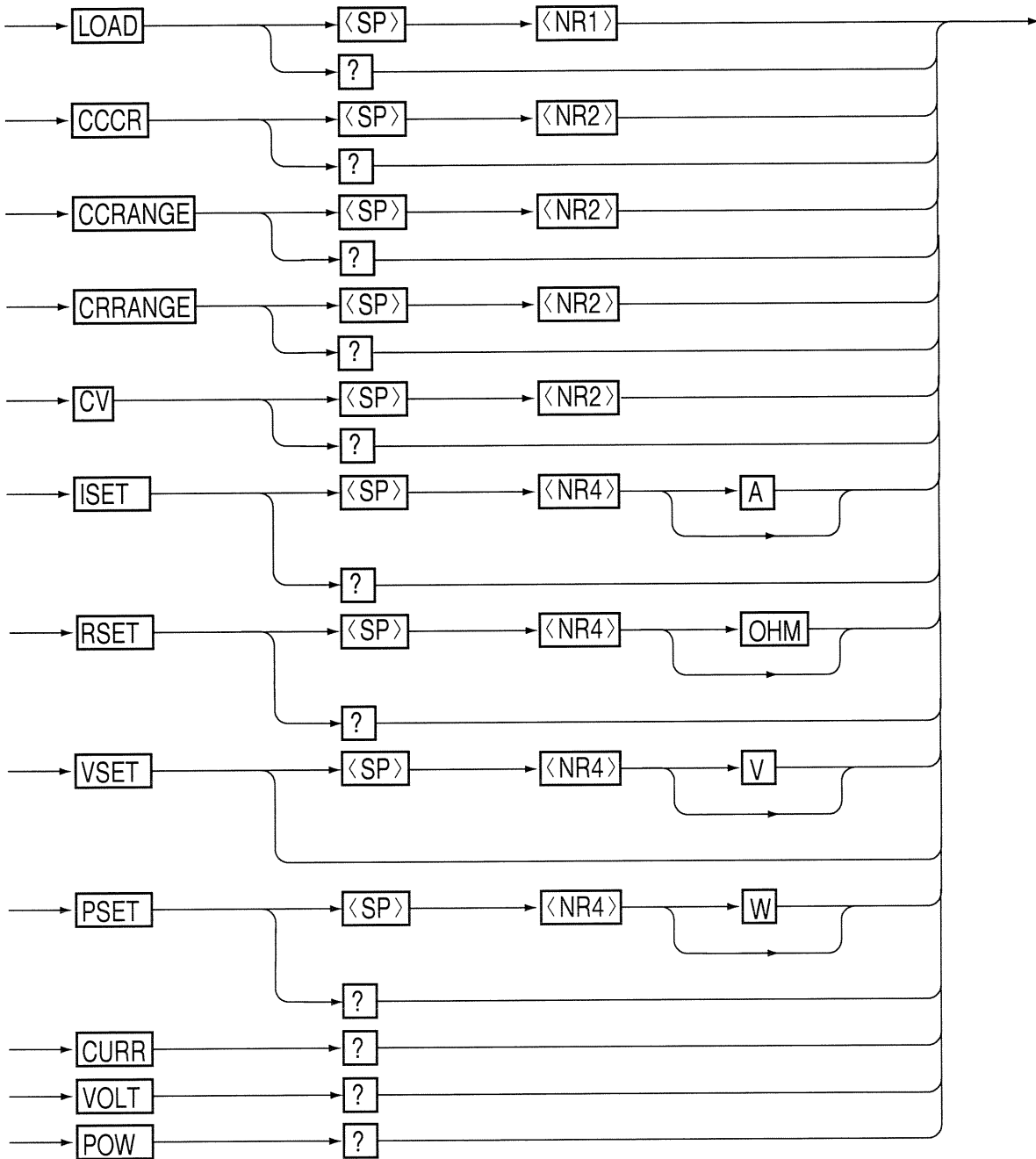


Fig. 5.3-1

Table 5.3-2

Header	Data	Action	Backup
LOAD	0 (OFF)	Turns off the load.	None
	1 (ON)	Turns on the load.	
LOAD?		Returns "0, 1".	
CCCR	1	Enables CC mode.	Available
	2	Enables CR mode.	
CCCR?		Returns "0, 1".	None
CCRANGE	0	Sets the CC mode range to L.	Available
	1	Sets the CC mode range to H.	
CCRANGE?		Returns "0, 1".	None
CRRANGE	0	Sets the CR mode range to L.	Available
	1	Sets the CR mode range to H.	
CRRANGE?		Returns "0, 1".	None
CV	0 (OFF)	Disables CV mode.	Available
	1 (ON)	Enables CV mode.	
CV?		Returns "0, 1".	None
ISET	0 to maximum rating [A]	Sets the ISET value.	Available
		Returns the ISET value.	
RSET	Minimum to maximum resistance [OHM]	Sets the RSET value.	Available
		Returns the RSET value.	
VSET	0 to maximum rating [V]	Sets the VSET value.	Available
		Returns the VSET value.	
PSET	0 to maximum rating [W]	Sets the PSET value.	Available
		Returns the PSET value.	
CURR?		Returns the input current.	None
VOLT?		Returns the input voltage.	None
POW?		Returns the input power.	None

(b) Trigger setup command

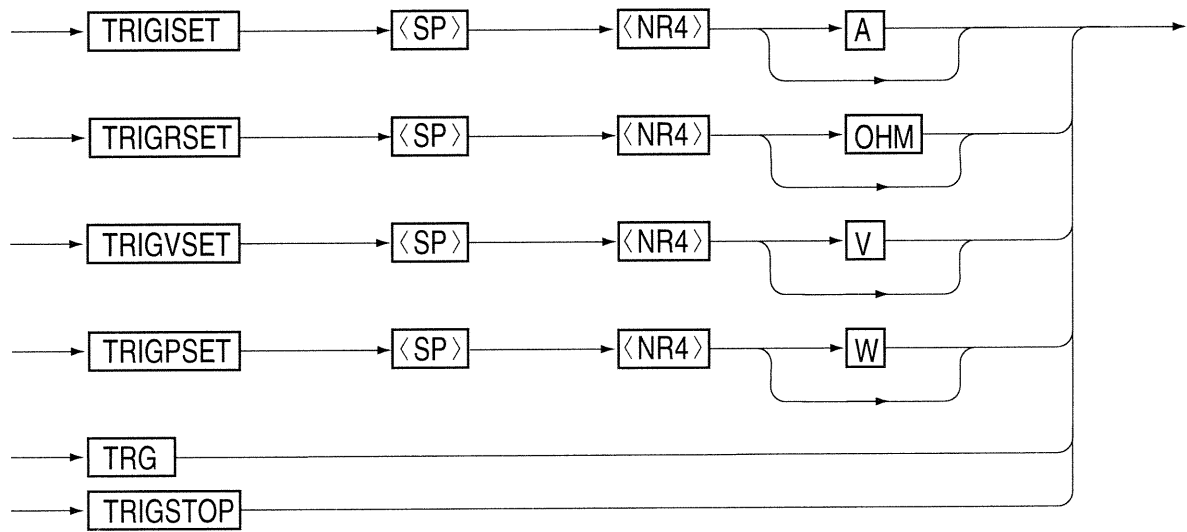


Fig. 5.3-2

Table 5.3-3

Header	Data	Action	Backup
TRIGISET	0 to maximum rating [A]	Sets the ISET value using the last TRG command.	None
TRIGRSET	Minimum to maximum resistance [OHM]	Sets the RSET value using the last TRG command.	None
TRIGVSET	0 to maximum rating [V]	Sets the VSET value using the last TRG command.	None
TRIGPSET	0 to maximum rating [W]	Sets the PSET value using the last TRG command.	None
TRG		Executes the last TRG:xxxx command and clears the TRG buffer.	None
TRIGSTOP			None

When another command is executed after the TRG buffer contents are defined by the TRIG:xxxx command and before the TRG command is executed, the TRG buffer is cleared. While TRG buffer is being cleared, the TRG command received is not executed. After the TRG command is executed, the TRG buffer is cleared. If the GET command is used instead of the TRG command, the same sequence occurs.

If the TRIGRSET command is executed in CC mode, an error will result. (Diff. Mode 15)

If the TRIGISET command is executed in CR mode, an error will result. (Diff. Mode 15)

(c) Memory command

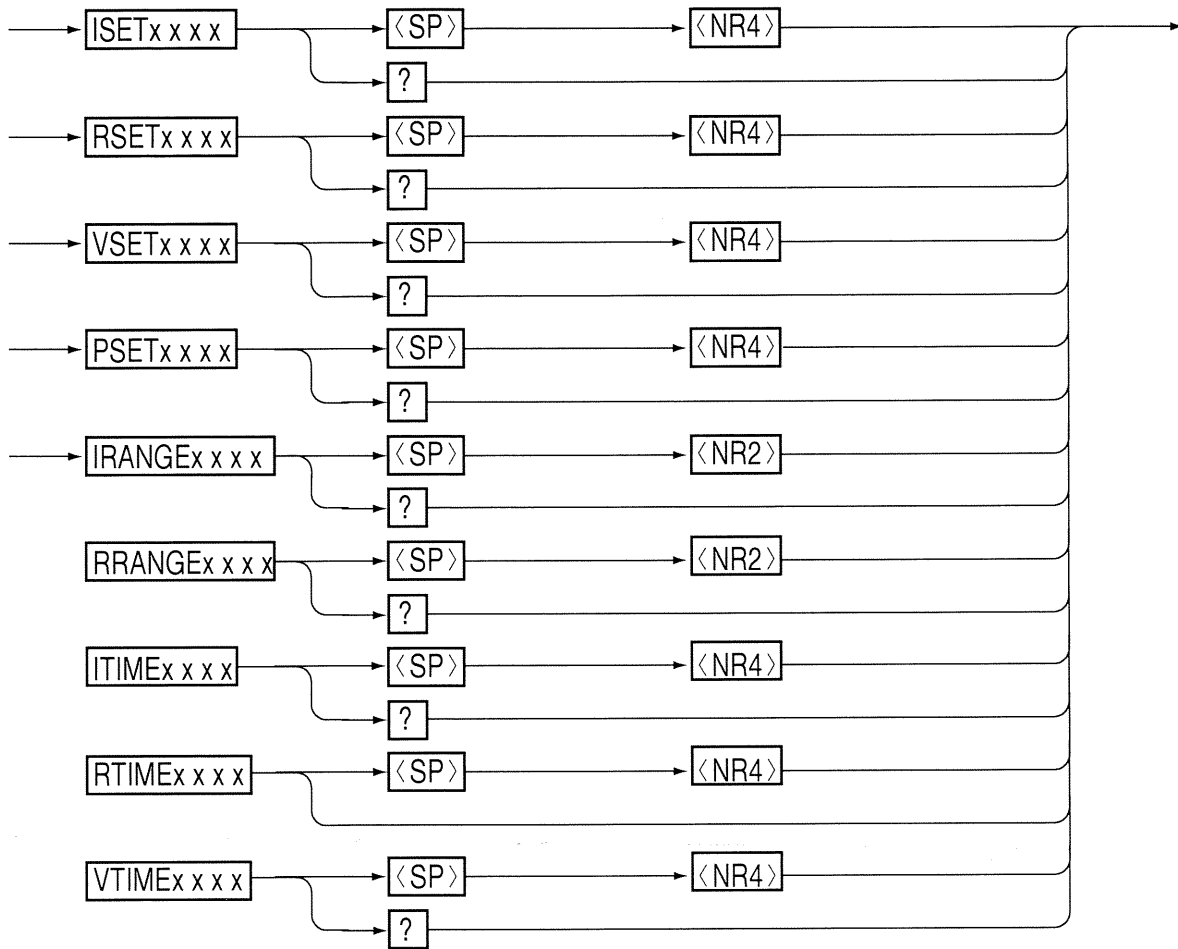


Fig. 5.3-3

xxxx: AMEM is used to access memory A, BMEM for memory B, and CMEM for memory C.

Table 5.3-4

Header	Data	Action	Backup
ISETxxxx	0 to maximum rating [A]	Saves the ISET value to the memory specified to xxxx.	Available
ISETxxxx?		Returns the ISET value in the memory specified to xxxx.	None
RSETxxxx	Minimum to maximum resistance [OHM].	Saves the RSET value to the memory specified to .xxxx	Available
RSETxxxx?		Returns the RSET value in the memory specified to xxxx.	None
VSETxxxx	0 to maximum rating [V]	Saves the VSET value to the memory specified to xxxx.	Available
VSETxxxx?		Returns the VSET value in the memory specified to xxxx.	None
PSETxxxx	0 to maximum rating [W]	Saves the PSET value to the memory specified to xxxx.	Available
PSETxxxx?		Returns the PSET value in the memory specified to xxxx.	None
IRANGExxxx	0	Saves the CC mode range L to the memory specified to xxxx.	Available
	1	Saves the CC mode range H to the memory specified to xxxx.	
IRANGExxxx?		Returns the CC mode range (0, 1) in the memory specified to xxxx.	None
RRANGExxxx	0	Saves the CR mode range L to the memory specified to xxxx.	Available
	1	Saves the CR mode range H to the memory specified to xxxx.	
RRANGExxxx?		Returns the CR mode range (0, 1) in the memory specified to xxxx.	None
ITIMExxxx	0 - 5 [s]	Saves the CC mode execution time to the memory specified to xxxx.	Available
ITIMExxxx?		Returns the CC mode execution time in the memory specified to xxxx.	None
RTIMExxxx	0 - 5 [s]	Saves the CR mode execution time to the memory specified to xxxx.	Available
RTIMExxxx?		Returns the CR mode execution time in the memory specified to xxxx.	None
VTIMExxxx	0 - 5 [s]	Saves the CV mode execution time to the memory specified to xxxx.	Available
VTIMExxxx?		Returns the CV mode execution time in the memory specified to xxxx.	None

(d) Special function command

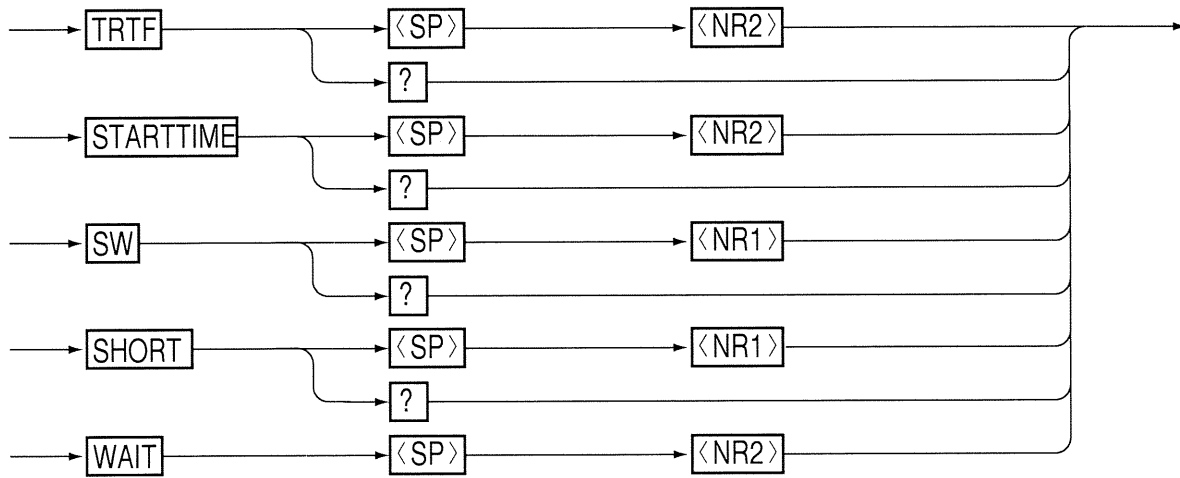


Fig. 5.3-4

Table 5.3-5

Header	Data	Action	Backup
TRTF	0	Sets TrTf to 50 μ s.	Available
	1	Sets TrTf to 100 μ s.	
	2	Sets TrTf to 200 μ s.	
	3	Sets TrTf to 500 μ s.	
	4	Sets TrTf to 1 ms.	
	5	Sets TrTf to 2 ms.	
	6	Sets TrTf to 5 ms.	
	7	Sets TrTf to 10 ms.	
TRTF?		Returns the value of TrTf.	None
STARTTIME	0	Sets the soft-start time to 0.5 ms.	Available
	1	Sets the soft-start time to 1 ms.	
	2	Sets the soft-start time to 2 ms.	
	3	Sets the soft-start time to 5 ms.	
	4	Sets the soft-start time to 10 ms.	
	5	Sets the soft-start time to 20 ms.	
	6	Sets the soft-start time to 50 ms.	
	7	Sets the soft-start time to 100 ms.	
STARTTIME?		Returns the soft-start time.	None
SW	0 (OFF)	Ends the switching operation.	None
	1 (ON)	Starts the switching operation. (Select the relevant mode using the CC or CR command, before the operation begins.)	
SW?		Returns 0 or 1.	
SHORT	0 (OFF)	Ends the short operation.	None
	1 (ON)	Starts the short operation.	
SHORT?		Returns 0 or 1.	
WAIT	0 - 5 [s]	Executes the blank process for the period of <NR2> second.	None

(e) Setup command

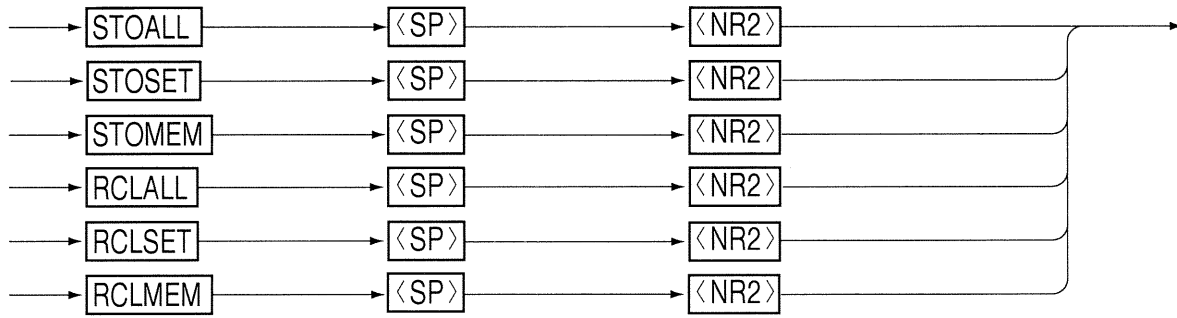


Fig. 5.3-5

Table 5.3-6

Header	Data	Action	Backup
STOALL	1 - 4	Saves the ALL settings to the specified setup memory.	None
STOSET	1 - 4	Saves the SET settings to the specified setup memory.	None
STOMEM	1 - 4	Saves the MEM settings to the specified setup memory.	None
RCLALL	0 - 4	Calls the ALL settings from the specified setup memory. When 0 is specified, the defaults of ALL are called.	None
RCLSET	0 - 4	Calls the SET settings from the specified setup memory. When 0 is specified, the defaults of SET are called.	None
RCLMEM	0 - 4	Calls the MEM settings from the specified setup memory. When 0 is specified, the defaults of MEM are called.	None

(f) Sequence command (1)

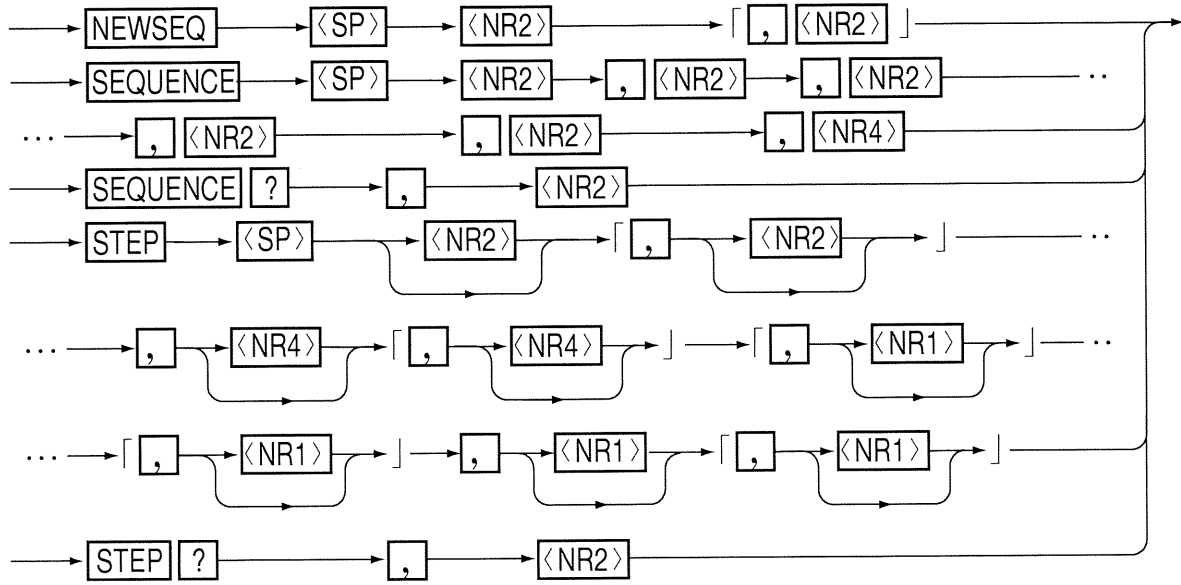


Fig. 5.3-6

Table 5.3-7

Header	Argument number	Data	Action	Backup
NEWSEQ	①	1	Sets to the NV mode. (The second argument ② exists.)	None
		2	Sets to the NI mode. (The second argument ② exists.)	
		4	Sets to the NR mode. (The second argument ② exists.)	
		5	Sets to the NP mode. (The second argument ② exists.)	
		11	Sets to the FI mode.	
		12	Sets to the FR mode.	
	②	1	Sets to the msec range.	
		2	Sets to the sec range.	
		3	Sets to the minute range.	
		4	Sets to the hour range.	
SEQUENCE	①	1 - 8	Specifies the sequence number.	Available
	②	1 - 16	Specifies the start program.	
	③	1 - 9999	Specifies the number of loops (9999: infinite).	
	④	0, 1 - 8	Specifies the chain sequence number (0: no specification).	
	⑤	0, 1 - 16	Specifies the end program number (0: no specification).	
	⑥	0.0001 - 0.1	Specifies the execution time in the unit "s" in the FI or FR mode.	
SEQUENCE?		1 - 8	Returns the parameter of the specified sequence number.	None
STEP	①	1 -	Specifies the step number.	Available
	* ②	0	Specifies the step transition.	
		1	Specifies the ramp transition.	
	③	Set value	Sets the value for each mode.	
	* ④	(Time)	Specifies the time in unit of "s".	
		0 (OFF)	Sets the trigger output to "off".	
	⑤	1 (ON)	Sets the trigger output to "on."	
		* ⑥	0 (OFF)	
	⑥	1 (ON)	Specifies a load on.	
		* ⑦	0 (OFF)	
⑦	1 (ON)	Enables the short function.		
	* ⑧	0 (OFF)	Sets the pause to "off. "	
⑧	1 (ON)	Sets the pause to "on."		
	STEP ?		1 -	Returns the parameter of the specified step number.

The arguments marked by "*" are not needed in the FI and FR modes.

(g) Sequence command (2)

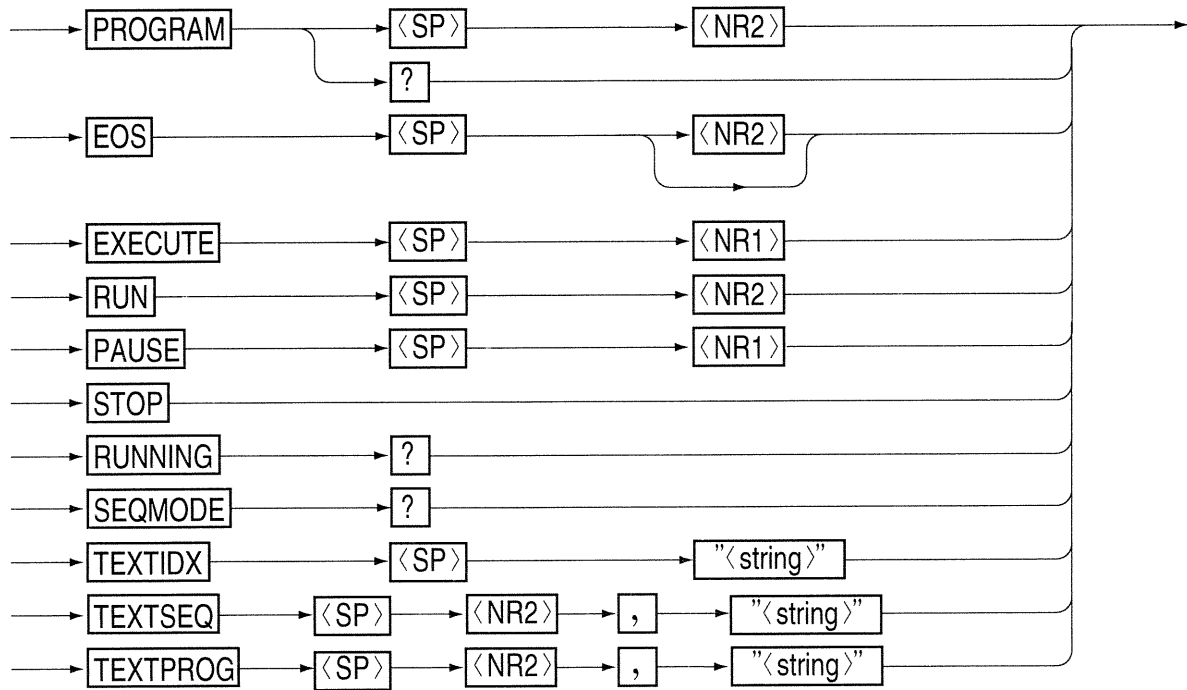


Fig. 5.3-7

Table 5.3-8

Header	Data	Action	Backup	
PROGRAM	1 - 16	Specifies the program number (the program number is valid for the STEP and EOS commands thereafter.)	None	
PROGRAM?		Returns the specified program number.	None	
EOS	1 - 1024	Sets the final step number of the specified program. (The data can be omitted.)	None	
EXECUTE	1 (ON)	Selects the execution mode to enable the RUN, STOP, and PAUSE keys.	None	
	0 (OFF)	Cancels the execution mode.		
RUN	1 - 8	Executes the sequence having the specified number.	None	
PAUSE	1 (ON)	Pauses the sequence operation.	None	
	0 (OFF)	Removes the pause from the sequence operation.		
STOP		Ends the sequence operation forcibly.	None	
RUNNING?		Returns the sequence execution status information. <1 - 3>,<SEQ.NO>,<PROG.NO>,<STEP.NO>,<LOOP> 1.....STOP 2.....RUN 3.....PAUSE	None	
SEQMOD?		Returns the sequence mode information. 1: NV mode 2: NI mode 4: NR mode 5: NP mode 11: FI mode 12: FR mode	None	
TEXTIDX	Character string	Adds an index of up to 6 characters to the sequence execution memory.	Available	
TEXTSEQ	①	1 - 8	Specifies the sequence number.	Available
	②	Character string	Adds a comment of up to 6 characters to the specified sequence number.	
TEXTPROG	③	1 - 16	Specifies the program number.	Available
	④	Character string	Adds a comment of up to 6 characters to the specified program number.	

(h) System command

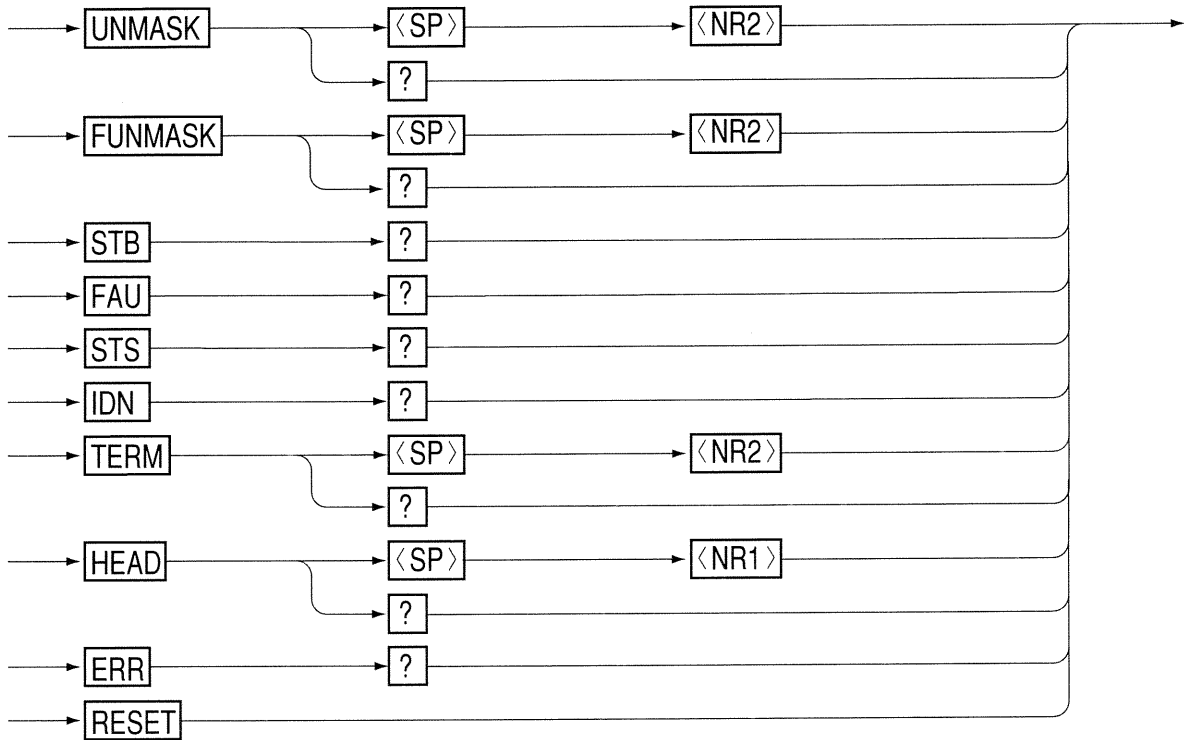


Fig. 5.3-8

Table 5.3-9

Header	Data	Action	Backup
UNMASK	0 - 255	Sets the unmask register.	None
UNMASK?		Returns the unmask value in decimal format.	
FUNMASK	0 - 255	Sets the fault unmask register.	None
FUNMASK?		Returns the fault unmask register value in decimal format.	
STB?		Returns the status byte register value in decimal format.	None
FAU?		Returns the fault register value in decimal format.	None
STS?		Returns the status register value in decimal format.	None
IDN?		Returns the type, ROM version, etc.	None
TERM	0	Sets the response terminator to "CRLF".	None
	1	Sets the response terminator to "CR".	
	2	Sets the response terminator to "LF".	
	3	Sets the response terminator to "EOI".	
TERM?		Returns 0, 1, 2, or 3.	
HEAD	1	Adds a header to the query message.	None
	0	Disables adding a header to the query message.	
HEAD?		Returns 0 or 1.	
ERR?		Returns an error code (see Section 5.6 "Error Codes").	None
RESET	None	Resets the alarm.	None

(i) MCB dedicated command

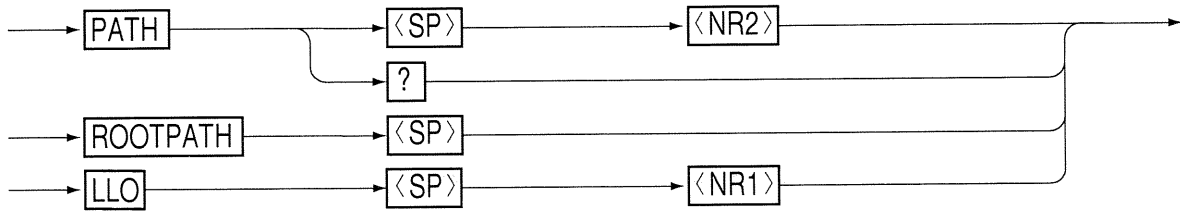


Fig. 5.3-9

Table 5.3-10

Header	Data	Action	Backup
PATH	Address (0 to 15, and 16)	Sets an MCB path address. (To set all the addresses, select "16".)	None
PATH?		Returns the MCB path address.	
ROOTPATH		Sets the path address to 0.	None
LLO	1 (ON)	Sets the local lockout	None
	0 (OFF)	Cancels the local lockout.	

NOTE

- Be sure to specify a valid MCB path address. If a nonexistent address is specified, sending the DCL command to GPIB sets the path address to 0 (master unit).
- The data for a path address of 0 (master unit) is returned as a query message response against the path address "16".

(j) RS-232C dedicated command and control code

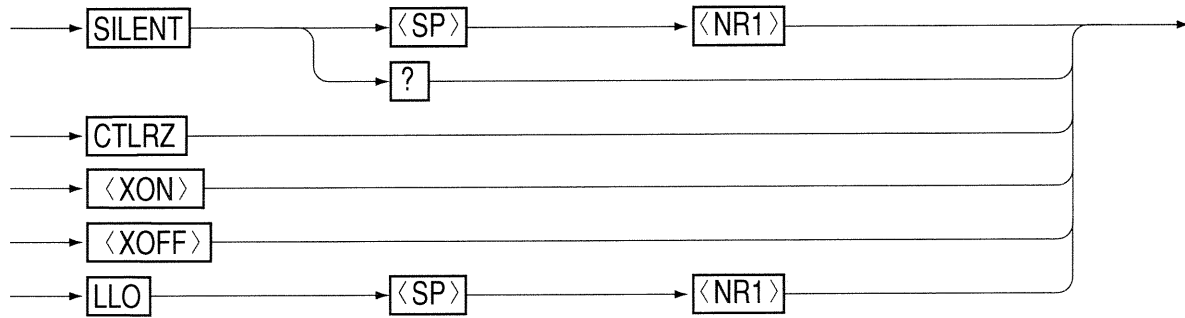


Fig. 5.3-10

Table 5.3-11

Header	Data	Action	Backup
SILENT	1 (ON)	Disables return of an acknowledge message.	None
	0 (OFF)	Returns an acknowledge message.	
SILENT?		Returns 1 or 0.	
CTRLZ		Returns the control Z code (1Ah).	None
< X ON > (11 h)		Resumes transmission from RS-232C interface (see Section 5.2.4, "Flow Control").	None
< X OFF > (13 h)		Stops transmission from RS-232C.	
LLO	1 (ON)	Sets the local lockout.	None
	0 (OFF)	Cancels the local lockout.	

(k) GPIB dedicated command and special code

DCL command : Sets the MCB path address to 0 and clears the error message.

SDC command : Same as DCL command.

GET command : Same as TRG command.

"@" code : After this "@" code (40h) is added to the end of the command, a "hold off" is enabled until the execution is complete.

However, in the event of a program message terminator with only EOI, use "@@".

Example:

20 PRINT @1; "ISET 5.0A" (Sends a message to the input buffer and goes to next process.)

30 PRINT @1; "ISET 5.0A@" (Executes ISET 5.0 A and goes to next process.)

5.4 Register Bit Assignment

When “True” is established, the bit becomes “1”.

(a) Status byte register

7	6	5	4	3	2	1	0
X	R Q S	X	M C B	E R R	S E	P O N	F A U

- Bit 0 (FAU): Shows that any bit in the fault register is “True”.
 Bit 1 (PON): Shows that the power is turned on.
 Bit 2 (SE): Shows that the sequence is complete.
 Bit 3 (ERR): Shows that an error such as syntax error has occurred.
 Bit 4 (MCB): Shows that a service request is received from MCB.
 Bit 5 (X): Indefinite.
 Bit 6 (RQS): Shows that a service request is generated.
 Bit 7 (X): Indefinite.

Bits 1 and 6 are valid only for the GPIB interface board. Bit 3 is reset by the ERR? query. Bit 6 is reset by the GPIB serial poll. Bits 1 and 2 are indefinite against the STB? query.

(b) Unmask register

7	6	5	4	3	2	1	0
			M C B	E R R	S E		F A U

- Bit 0 (FAU): Generates a service request when any bit in the fault register is “True”.
 Bit 1
 Bit 2 (SE): Generates a service request when the sequence is complete.
 Bit 3 (ERR): Generates a service request when an error such as a syntax error occurs.
 Bit 4 (MCB): Generates a service request in response to the service request from MCB.
 Bit 5
 Bit 6
 Bit 7

Set unused bits to 0 (zero).

(c) Fault register

7	6	5	4	3	2	1	0
CP	CV	EXTALM	FB	REV	OHP	OCP	OV

- Bit 0 (OV): Detects an overvoltage
 Bit 1 (OCP): OCP mode
 Bit 2 (OHP): OHP mode
 Bit 3 (REV): Detects a reverse voltage.
 Bit 4 (FB): Detects blown fuse.
 Bit 5 (EXTALM): Detects an external alarm.
 Bit 6 (CV): CV mode
 Bit 7 (CP): CP mode

These register bits have a latch function, and the set status is held until the register is read by the FAU? query.

(d) Fault unmask register

7	6	5	4	3	2	1	0
CP	CV	EXTALM	FB	REV	OHP	OCP	OV

- Bit 0 (OV): Enables operation of the OV bit of the fault register.
 Bit 1 (OCP): Enables operation of the OCP bit of the fault register.
 Bit 2 (OHP): Enables operation of the OHP bit of the fault register.
 Bit 3 (REV): Enables operation of the REV bit of the fault register.
 Bit 4 (FB): Enables operation of the FB bit of the fault register.
 Bit 5 (EXTALM): Enables operation of the EXTALM bit of the fault register.
 Bit 6 (CV): Enables operation of the CV bit of the fault register.
 Bit 7 (CP): Enables operation of the CP bit of the fault register.

Set unused bits to 0 (zero).

(e) Status register

7	6	5	4	3	2	1	0
CP	CV	EXTALM	FB	REV	OHP	OCP	OV

- Bit 0 (OV): Detects an overvoltage
 Bit 1 (OCP): OCP mode
 Bit 2 (OHP): OHP mode
 Bit 3 (REV): Detects a reverse voltage.
 Bit 4 (FB): Detects blown fuse.
 Bit 5 (EXTALM): Detects an external alarm.
 Bit 6 (CV): CV mode
 Bit 7 (CP): CP mode

5.5 Register and SRQ, and Status Byte

The PLZ-3WH series electronic load unit notifies the controller of events generated inside the unit, using several registers. The following chart shows the relationship between the register and SRQ, and the status byte. (SRQ is a function unique to GPIB.)

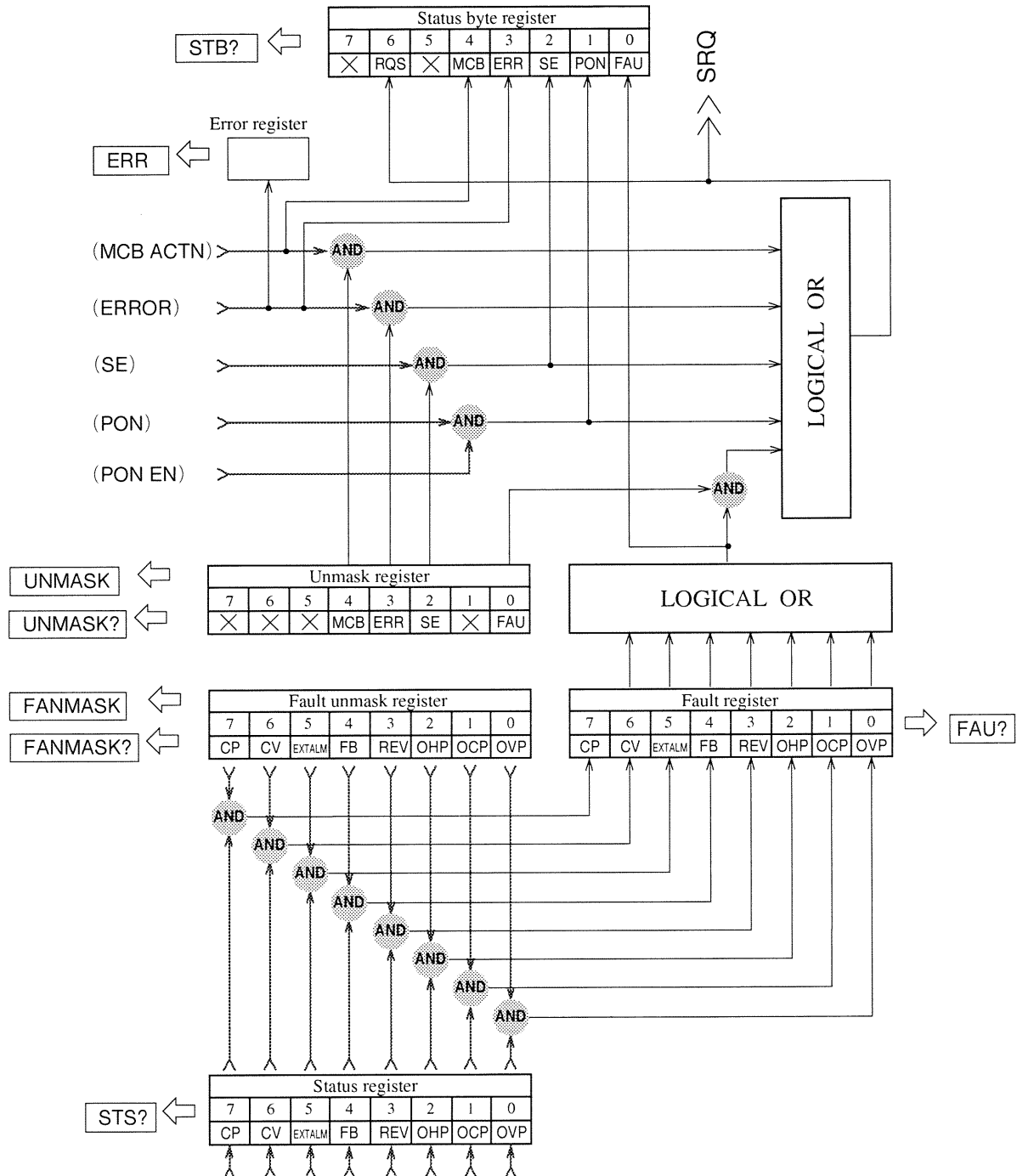


Fig. 5.5-1

5.6 Error Codes

The table below lists the error codes used in the PLZ-3WH series electronic load unit.

Table 5.6-1

Error message	Error code	Cause
Syntax Error	1	The command input has a syntax error.
Argument Err	2	The argument of the command line is faulty.
Memory Full	14	The memory size is too small to write the sequence program steps.
Diff. Mode	15	The basic operating mode settings are not suitable for the command sent.
Warning Data	16	The sequence contains the set value exceeding the rating.
SW State	21	An invalid command was input during a switching operation.
SEQ State	22	An invalid command was input during a sequence operation (RUN or PAUSE).
SHORT State	23	An invalid command was input during a short operation.
Alarm state	24	A command was input while an alarm was in effect.
SLAVE State	25	An invalid command was input during a slave operation.
EXECUTE 0	27	The sequence cannot be executed. (To implement the sequence, execute the EXECUTE 1 and RUN commands in this order.)
Invalidity	28	An invalid command was input.

The error generated is written to the register. Therefore, the error code of the last error is returned in response to an ERR? query. After the relevant error code is returned, the error register can be cleared with the CLR, DCL, or SDC command.

6

Chapter 6 Maintenance and Calibration

This chapter describes how to maintain, inspect, and calibrate the PLZ-3WH series electronic load unit.

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6.1 Maintenance and Calibration

Periodic maintenance and inspection is essential if your PLZ-3WH series electronic load unit is to maintain its initial performance over an extended period.

6.1.1 Cleaning the Panel Surface

Before cleaning the panel surface, be sure to disconnect the input power plug and/or turn off the switchboard. Dampen a soft cloth with a neutral detergent diluted with water, and gently wipe the panel surface to remove any stains.

CAUTION

Do not use solvents such as benzine or thinner. Otherwise, the display may become clouded, causing characters to become illegible, or the panel surface may become discolored.

6.1.2 Cleaning the Dust Filter

Before cleaning the dust filter, be sure to disconnect the input power plug and/or turn off the switchboard. A clogged filter will diminish interior cooling performance and consequently cause the unit to fail or experience reduced service life. Clean the filter periodically to prevent serious clogging.

Removing and attaching the louver

To remove the louver, push down its bottom projection and pull the louver out. For PLZ153WH and PLZ303WH load units, remove the knobs from the auxiliary load terminals before removing the louver. To attach the louver, mate the convex side on the louver top with the concave side on the load unit, fit the louver bottom into the chassis, and then push up the projection and fix the louver in place.

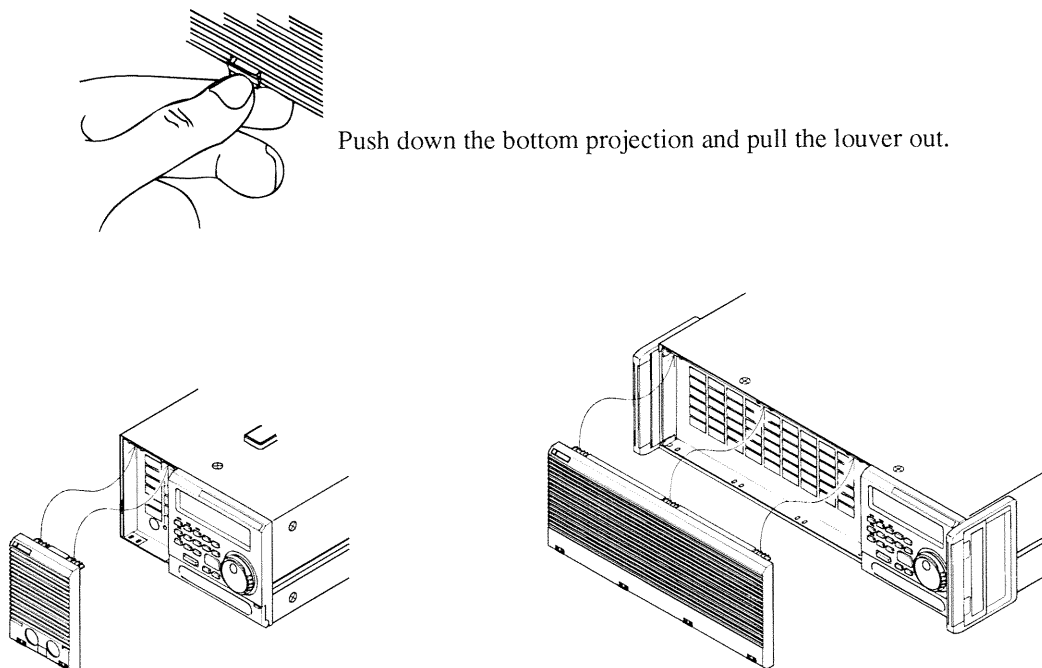


Fig. 6.1-1

6.1.3 Inspection of AC Power Cable

Check the AC power cable for breaks in its exterior protective cover, cracked plugs or rattling, and loosened set bolts.

6.1.4 Performance Check

The load unit is strictly calibrated before shipment from the factory. To maintain its accuracy, we recommend that its performance be examined periodically. Use the following procedure to check the unit's performance.

● Preparation

Before a performance check, warm up the load unit for at least 20 minutes. This minimizes the measurement error caused by initial drift. Maintain the ambient temperature at $23 \pm 5^\circ\text{C}$.

● Test equipment required

The following measuring instruments are needed.

- Class 0.1 % shunt resistor (having a rated current larger than your load unit)
- Voltmeter having measuring accuracy of 0.02 % or better (DVM)
- Regulated DC power supply (i.e., constant-voltage and constant-current power supply), which supplies the rated voltage and current of your load unit

● Connection of equipment

Connect the measuring instruments to the load unit as illustrated below.

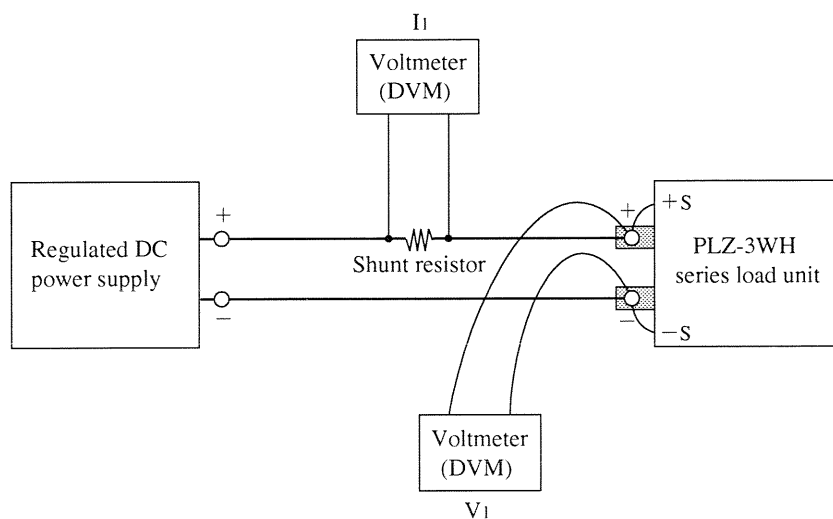


Fig. 6.1-2

Connect the voltmeter to the ET lug of the load terminal as illustrated below.

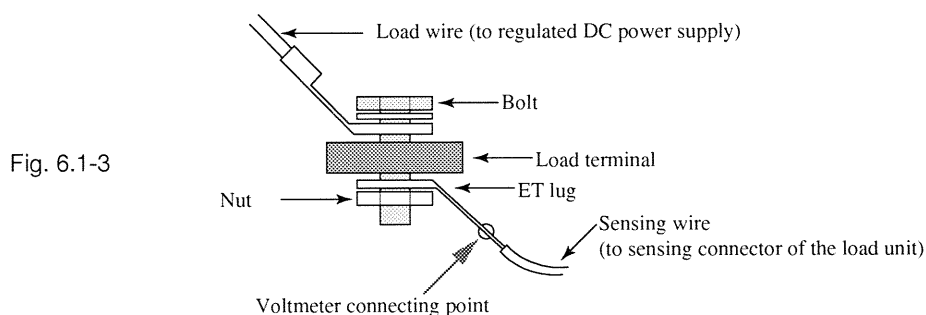


Fig. 6.1-3

● **Checking**

Check the performance as shown in the table below.

Table 6.1-1

Check item	Setting	Examination
Set accuracy of constant current mode	Set the output of the regulated DC power supply so that load terminal voltage is 5.0 V. Set the ISET value to the rated current. (Set the PSET value to maximum and turn off the CV mode.)	Check that "ISET value - I_1 " falls within the accuracy range defined in the unit specifications.
Set accuracy of constant resistance mode	Set the load terminal voltage to 12.0 V and the RSET value to minimum resistance. (Set the PSET value to maximum and turn off the CV mode.)	Check that " V_1 /RSET value - I_1 " falls within the accuracy range defined in the unit specifications.
Set accuracy of constant power mode	Set the load terminal voltage to 20.0 V and the CP value to rated power. (Set the ISET value to maximum or the RSET value to minimum, and turn off the CV mode.)	Check that "PSET value - $V_1 \times I_1$ " falls within the accuracy range defined in unit specifications.
Set accuracy of constant voltage mode	Set the output of the regulated DC power supply to 22 V and the current to 1 A. Turn on the CV mode and set the VSET value to 20 V. (Set both ISET and PSET values to maximum.)	Check that "VSET value - V_1 " falls within the accuracy range defined in unit specifications.

If the results of the performance check indicate a failure for even one checked item, you must calibrate the load unit. For information on the calibration procedure see Section 6.2, "Calibration".

6.1.5 Overhaul

The load unit's electrolytic capacitors, fan motor, and memory-backup chargeable batteries are consumable parts. We recommend that your load unit be overhauled every 10,000 operating hours together with checkout and cleaning of interior, although the exact interval depends on usage conditions. Order an overhaul from your Kikusui agent.

6.2 Calibration

The load unit needs to be calibrated whenever the results of the performance check indicates a failure for even one checked item. This section explains how to calibrate the load unit.

6.2.1 Preparation

Before the calibration, warm up the load unit for at least 20 minutes. This minimizes the measurement error caused by initial drift. Maintain the ambient temperature at $23 \pm 5^\circ\text{C}$.

6.2.2 Test equipment required

The following measuring instruments are needed.

- DC voltmeter having measuring accuracy of 0.01 % or better (DVM)
- Shunt resistor having accuracy of 0.1 % or better (its rated current should be larger than that of your load unit)
- DC constant-voltage and constant-current power supply

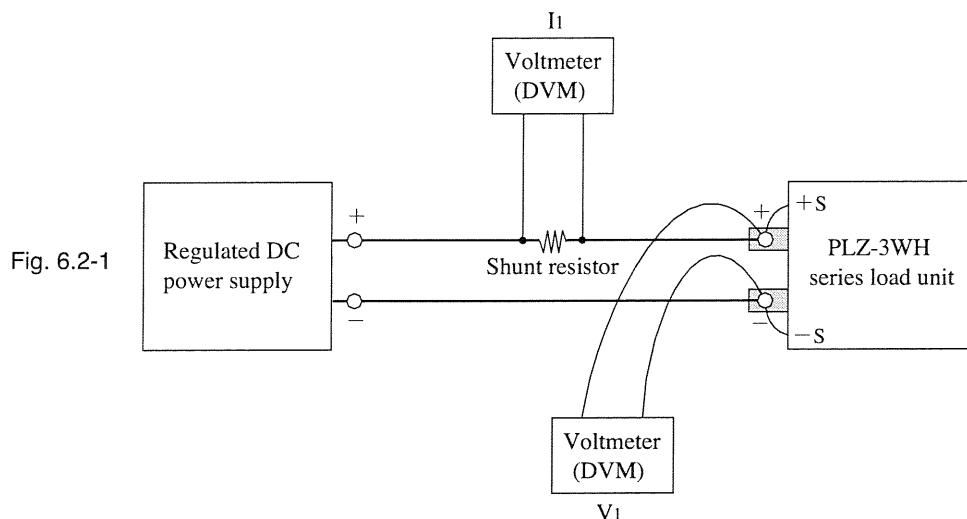
If you intend to use only one power supply, a large-capacity one is needed since the load unit accommodates both low-voltage, high-current and high-voltage, low-current operations. However, you can also prepare two power supplies, so that one power supply covers the low-voltage, high-current operations and the other covers the high-voltage, low-current operations. The table below shows possible combinations of our PAD-L or PAN series power supplies.

Table 6.2-1

Calibration item	Model			
	PLZ153WH	PLZ303WH	PLZ603WH	PLZ1003WH
(1)-(8), (11), (12) (15)-(18)	PAN35-10 PAD35-10L	PAN35-20 PAD35-20L	PAN35-30 PAD35-30L	PAD35-50L
(9), (10), (13), (14)	PAD500-0.6A	PAD500-0.6A	PAD500-1.2A	PAD500-2L

6.2.3 Connection of Equipment

Connect the voltmeter (V1) to the load terminal of the load unit. Read the potential difference observed on the shunt resistor from the voltmeter, and calculate the input current (I1) from it.



6.2.4 Calibration Mode

To calibrate the load unit, first use the following procedure to put the device into calibration mode.

CAUTION

When you want to cancel the calibration midway, press the [ESC] key. This will return display to the Configuration Menu. Before turning off the load unit, always return to this menu. If the load unit is turned off before being returned to this menu, the calibrated values will be lost.

(1) Press [SHIFT] + [R SET] (CONFIG) keys to display the Configuration Menu. Select the menu item "16: Calibration" with the arrow keys, and press the [ENTER] key.

```
> 16: Calibration
      Push [ENTER]
```

(2) The display request for you to enter the ID number of your load unit. Using the jog-shuttle, specify the ID number. The following ID numbers are assigned to PLZ-3WH series electronic load units, respectively.

```
PLZ153WH: 0153
PLZ303WH: 0303
PLZ603WH: 0603
PLZ1003WH: 1003
```

```
> 1: Start Calibration
      ID? 0000
```

(3) This example shows the ID number "0153". After entering the ID number, press the [ENTER] key. If an incorrect ID number is input, a buzzer sounds. In this case, reenter the ID number.

```
> 1: Start Calibration
      ID? 0153
```

(4) Now the load unit is ready for calibration. In this example, the H range offset of the CC mode is selected. You can see that 20.0 V is applied to the load terminal and "62" has been set before shipment from the factory or at the previous calibration.

```
0.00A      20.0V      0.0W
-- --      offsCCdaH      62
```

CAUTION

- Since the current is changed during the calibration, the voltage applied to the load terminal varies due to the voltage drop in the load wires. Therefore, you need to perform a readjustment so that the specified voltage is obtained.
- The range offset and maximum should be calibrated in each mode. When the maximum is calibrated after a range offset calibration, the offset may deviate from the calibrated value. To calibrate these two values correctly, repeat the calibration in alternate modes.

6.2.5 Calibration Procedure

For items (1) through (12), calibrate both the range offset and maximum in the CC, CR, CV, and CP modes. The values in the upper field of the display are pre-calibration values and, therefore, differ from the measurements obtained on the external equipment.

For items (13) through (18), calibrate both the ammeter and voltmeter. (Since the power meter indicates the product of the indicated values on the ammeter and voltmeter, no calibration is necessary.)

The table below lists calibration references for PLZ-3WH series electronic load units.

Table 6.2-2

Calibration item	Model			
	PLZ153WH	PLZ303WH	PLZ603WH	PLZ1003WH
(1) offsCCdaH	78.8mA	158mA	315mA	525mA
(2) gainCCdaH	6.30A	12.60A	25.20A	42.00A
(3) offsCCdaL	7.9mA	16mA	32mA	53mA
(4) gainCCdaL	0.630A	1.260A	2.520A	4.200A
(5) offsCRdaH	78.8mA	158mA	315mA	525mA
(6) gainCRdaH	6.30A	12.60A	25.20A	42.00A
(7) offsCRdaL	7.9mA	16mA	32mA	53mA
(8) gainCRdaL	0.630A	1.260A	2.520A	4.200A
(9) offsCVda	5.00V	5.00V	5.00V	5.00V
(10) gainCVda	400.0V	400.0V	400.0V	400.0V
(11) offsCPda	78.8mA	158mA	315mA	525mA
(12) gainCPda	6.30A	12.60A	25.20A	42.00A
(13) offsVad	5.00V	5.00V	5.00V	5.00V
(14) gainVad	400.0V	400.0V	400.0V	400.0V
(15) offsIadNorm	0.00A	0.00A	0.00A	0.00A
(16) gainIadNorm	6.30A	12.60A	25.20A	42.00A
(17) offsIadSum	0.00A	0.00A	0.00A	0.00A
(18) gainIadSum	1.58A	3.15A	6.30A	10.50A

To select a calibration item, use the [▷] and [◁] keys. For the selected item, the load is automatically turned off to ensure safety. To start the calibration, press the [LOAD] switch. The voltage and current actually applied to the load terminal, and the power, are indicated in the upper field of the display. The selected calibration item and presently calibrated value are indicated in the lower field. Take note of the present calibrated value and then execute the calibration. Whenever setting the calibration reference for one item, select the next item with the [▷] and [◁] keys, or press the [ESC] key to return to the Configuration Menu.

Each item is calibrated using the following procedure (the number on the left end shows the item number).

- (1) offsCCdaH (calibration of H range offset in CC mode)

After selecting the item, press the [LOAD] switch to turn on the load and apply 20.0 V to the load terminal. Using the jog-shuttle, set the input current I_1 to the calibration reference.

0.079A	20.0V	1.6W
CC offsCCdaH		62

- (2) gainCCdaH (calibration of rated current in range H of CC mode)

After selecting the item, press the [LOAD] switch to turn on the load and apply 20.0 V to the load terminal. Using the jog-shuttle, set the input current I_1 to the calibration reference.

6.300A	20.0V	126.0W
CC gainCCdaH		25205

- (3) offsCCdaL (calibration of L range offset in CC mode)

After selecting the item, press the [LOAD] switch to turn on the load and apply 20.0 V to the load terminal. Using the jog-shuttle, set the input current I_1 to the calibration reference.

0.008A	20.0V	0.2W
CC offsCCdaL		178

- (4) gainCCdaL (calibration of maximum current in range L of CC mode)

After selecting the item, press the [LOAD] switch to turn on the load and apply 20.0 V to the load terminal. Using the jog-shuttle, set the input current I_1 to the calibration reference.

0.630A	20.0V	12.6W
CC gainCCdaL		25456

- (5) offsCRdaH (calibration of H range offset in CR mode)

After selecting the item, press the [LOAD] switch to turn on the load and apply 12.0 V to the load terminal. Using the jog-shuttle, set the input current I_1 to the calibration reference.

0.079A	12.0V	1.6W
CR offsCRdaH		72

- (6) gainCRdaH (calibration of minimum resistance in range H of CR mode)

After selecting the item, press the [LOAD] switch to turn on the load and apply 12.0 V to the load terminal. Using the jog-shuttle, set the input current I_1 to the calibration reference.

6.300A	12.0V	75.6W
CR gainCRdaH		21293

- (7) offsCRdaL (calibration of L range offset in CR mode)

After selecting the item, press the [LOAD] switch to turn on the load and apply 12.0 V to the load terminal. Using the jog-shuttle, set the input current I_1 to the calibration reference.

0.008A	12.0V	0.2W
CR offsCRdaL		112

- (8) gainCRdaL (calibration of minimum resistance in range L of CR mode)

After selecting the item, press the [LOAD] switch to turn on the load and apply 12.0 V to the load terminal. Using the jog-shuttle, set the input current I_1 to the calibration reference.

0.630A	12.0V	7.6W
CR	gainCRdaL	23456

- (9) offsCVda (calibration of offset in CV mode)

After selecting the item, set the power supply voltage and current limit to 450 V and 0.20 A with the load turned off. Press the [LOAD] switch to turn on the load and set the input voltage V_1 to the calibration reference with the jog-shuttle.

0.200A	5.0V	2.0W
CV	offsCVda	-6

- (10) gainCVda (calibration of maximum in CV mode)

After selecting the item, set the power supply voltage and current limit to 450 V and 0.20 A with the load turned off. Press the [LOAD] switch to turn on the load and set the input voltage V_1 to the calibration reference with the jog-shuttle.

0.200A	400.0V	96.0W
CV	gainCVda	21985

- (11) offsCPda (calibration of offset in CP mode)

After selecting the item, set the power supply voltage to 20.0 V with the load turned off. Press the [LOAD] switch to turn on the load and set the input current I_1 to the calibration reference with the jog-shuttle.

0.079A	20.0V	1.6W
CP	offsCPda	123

- (12) gainCPda (calibration of maximum in CP mode)

After selecting the item, set the power supply voltage to 20.0 V with the load turned off. Press the [LOAD] switch to turn on the load and set the input current I_1 to the calibration reference with the jog-shuttle.

6.300A	20.0V	126W
CP	gainCPda	22345

- (13) offsVad (calibration of voltmeter offset)

After selecting the item, press the [LOAD] switch to turn on the load and apply 5.00 V to the load terminal. Using the jog-shuttle, set the voltmeter reading to the calibration reference.

0.00A	5.0V	0.0W
CC	offsVad	1

- (14) gainVad (calibration of voltmeter maximum)

After selecting the item, press the [LOAD] switch to turn on the load and apply 400.0 V to the load terminal. Using the jog-shuttle, set the voltmeter reading to the calibration reference.

0.00A	400.0V	0.0W
CC	gainVad	28593

- (15) offsIadNorm (calibration of ammeter offset under single load unit operation)

After selecting the item, press the [LOAD] switch to turn on the load and apply 20.0 V to the load terminal. Using the jog-shuttle, set the ammeter reading to the calibration reference.

0.00A	20.0V	0.0W
CC	offsIadNorm	- 11

(16)gainIadNorm (calibration of ammeter maximum under signal load unit operation)

After selecting the item, press the [LOAD] switch to turn on the load and apply 20.0 V to the load terminal. Using the jog-shuttle, set the ammeter reading to the calibration reference.

6.300A	20.0V	126W
CC	gainIadNorm	26671

(17)offsIadSum (calibration of ammeter offset under parallel operation of multiple load units)

After selecting the item, press the [LOAD] switch to turn on the load and apply 20.0 V to the load terminal. Using the jog-shuttle, set the ammeter reading to the calibration reference.

0.000A	20.0V	0.0W
CC	offsIadSum	- 12

(18)gainIadSum (calibration of ammeter maximum under parallel operation of multiple load units)

After selecting the item, press the [LOAD] switch to turn on the load and apply 20.0 V to the load terminal. Using the jog-shuttle, set the ammeter reading to the calibration reference.

1.575A	20.0V	31.5W
CC	gainIadSum	26689

6.3 Ordering Repair Service

When your load unit does not work normally, check its condition once before you order any repair. If any of the following problems are observed, take action as described below. If this corrective action fails to remove the trouble, immediately unplug the AC power cable or turn off the switchboard, and order repair services to your Kikusui agent.

Problem

Even when the [POWER] switch is turned on, nothing appears on the display and the load unit is inoperative.

- | | |
|-----------|--|
| Checking: | <ul style="list-style-type: none"> • Is a voltage applied to the AC input terminal? • Is the fuse blown? |
| Cause: | <ul style="list-style-type: none"> • The AC power cable is broken. • The fuse is blown. |
| Action: | <ul style="list-style-type: none"> • Check the AC power cable. • Replace the fuse with spare part. (See Section 2.4.1, "Selecting the AC Input Voltage Range and Replacing Fuses" of Chapter 2.) |

Problem

After the [POWER] switch is turned on, the display is dark.

- | | |
|-----------|--|
| Checking: | <ul style="list-style-type: none"> • Is the AC input voltage low? • Is the select switch for the AC input voltage range set correctly? |
| Cause: | <ul style="list-style-type: none"> • The AC input voltage applied deviates from the specified range. • The input voltage select switch is incorrectly set. |
| Action: | <ul style="list-style-type: none"> • Apply the AC input voltage within the specified range. • Set the input voltage select switch correctly. (See Section 2.4.1, "Selecting the AC Input Voltage Range and Replacing Fuses" of Chapter 2.) |

Problem

The input current is unstable or an oscillation occurs.

- | | |
|-----------|---|
| Checking: | <ul style="list-style-type: none"> • Is the load wire forming a large loop? • Is the load wire too long? |
| Cause: | <ul style="list-style-type: none"> • The load wire forms a large loop. • Remote sensing is not being carried out. |
| Action: | <ul style="list-style-type: none"> • Conduct the remote sensing. • Attach a capacitor to the input terminal. (See Section 2.6, "Arrangement of Load Wires" of Chapter 2.) |

Problem

The set value cannot be determined.

- Checking: • Is the configuration set correctly?
- Cause: • "3: Preset" is set to "ON" in the Configuration Menu.
- Action: • When "3: Preset" is set to "ON", the set value is not determined as long as the [ENTER] key is not depressed. (See Section 4.4.9, "Configuration" of Chapter 4.)

Problem

Data cannot be called from any of the memories with the [A], [B], or [C] keys.

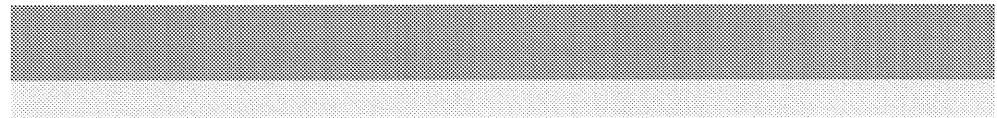
- Checking: • Is the configuration set correctly?
- Cause: • "4: Recall ABC Mem" is set to "Safety" in the Configuration Menu.
- Action: • When "4: Recall ABC Mem" is set to "Safety", the set value is not determined as long as the [ENTER] key is not depressed. (See Section 4.4.9, "Configuration" of Chapter 4.)

Problem

Values cannot be selected and set with the jog control.

- Checking: • Is the configuration set correctly?
- Cause: • "10: Resolution (I)", "11: Resolution (1/R)", "12: Resolution (V)", and "13: Resolution (P)" are set to "0" in the Configuration Menu.
- Action: • Set the desired values. (See Section 4.4.9, "Configuration" of Chapter 4.)

7



Chapter 7 Specifications

This chapter lists the electrical specifications, dimensions and weight, accessories, and available options of PLZ-3WH series load units.

7.1	Electrical Features	7-2
7.2	Dimensions and Weight	7-7
7.3	Accessories	7-8
7.4	Options	7-9

7.1 Electrical Features

Table 7.1-1

		PLZ153WH	PLZ303WH	PLZ603WH	PLZ1003WH	Unit		
Rating	Operating voltage (DC) *1	5 – 500				V		
	Current	7.5	15	30	50	A		
	Power	150	300	600	1000	W		
Constant current mode (CC mode)	Operating range	Range H	0 – 7.5	0 – 15	0 – 30	0 – 50	A	
		Range L	0 – 0.75	0 – 1.5	0 – 3	0 – 5	A	
	Set accuracy (against rated current) *2		±(0.3%+7.5mA)	±(0.3%+15mA)	±(0.3%+30mA)	±(0.3%+50mA)	–	
	Set resolution	Range H	2	4	8	13	mA	
		Range L	0.2	0.4	0.8	1.3	mA	
	Stability	Line variation *3	3				mA	
		Input voltage variation *4	20				mA	
	Temperature coefficient		Rated current ±100 (standard value)				PPM/°C	
	Ripple noise *5	RMS *6		2	2	3	5	mA
			Measured current	at 7.5 A	at 15 A	at 30 A	at 50 A	
Peak to Peak *7			20	20	30	50	mA	
		Measured current	at 7.5 A	at 15 A	at 30 A	at 50 A		

*1: Although the current can be supplied even in the range from 1 V to 5 V, the specifications are not met.

*2: The value is based on the temperature 23±5°C.

*3: The value is based on the variation of “line voltage central value ±10%” at the rated current determined by the input voltage 20V.

*4: The value is based on the input voltage variation from 5 V to 500 V at the current determined by the rated power/input voltage 500V.

*5: The value is based on the rated current determined by the input voltage 20 V.

*6: 5 Hz to 500 kHz

*7: DC to 15 MHz

Table 7.1-2

		PLZ153WH	PLZ303WH	PLZ603WH	PLZ1003WH	Unit	
Constant resistance mode (CR mode)	Operating range	Range H	1.6 – 20k	0.8 – 10k	0.4 – 5k	0.24 – 3k	OHM [Ω]
			$0.625 - 5 \times 10^{-5}$	$1.25 - 1 \times 10^{-4}$	$2.5 - 2 \times 10^{-4}$	$4.17 - 3.3 \times 10^{-4}$	siemens [S]
		Range L	16 – 200k	8 – 100k	4 – 50k	2.4 – 30k	OHM [Ω]
			$0.0625 - 5 \times 10^{-6}$	$0.125 - 1 \times 10^{-5}$	$0.25 - 2 \times 10^{-5}$	$0.417 - 3.3 \times 10^{-5}$	siemens [S]
	Set resolution	Range H	0.156	0.3125	0.625	1	millsiemens
		Range L	0.0156	0.03125	0.0625	0.1	[mS]
	Set accuracy (against rated current) *1		± (1 % of rated current + α) *3				–
	Stability	Input voltage variation *2	6				%
Temperature coefficient		±(1000ppm/°C + 4 mΩ/°C) at minimum resistance (standard value)				–	
Ripple noise *4		As specified in graph 1 (standard value)				–	

*1: The value is based on the input voltage 12 V at 23±5°C.

*2: The value is based on an input voltage variation from 5 V to 12 V at minimum resistance. In other cases, the resistance must not exceed 6 % of the maximum conductance [S] of the set range at variation of total input voltage. The load terminal is subject to remote sensing.

*3: $\alpha = 12 \text{ V} \div \text{set resistance} - 12 \text{ V} \div (\text{set resistance} + 120 \text{ m}\Omega)$

*4: Cyclic noise of about 155 kHz may overlap the input current.

NOTE

Conductance [S] x input voltage [V] = load current [A]

Conductance [S] = 1/resistance [Ω]

Table 7.1-3

		PLZ153WH	PLZ303WH	PLZ603WH	PLZ1003WH	Unit
Constant voltage mode (CV mode)	Operating range (DC)	5 – 500				V
	Set accuracy *1	Rated voltage ± 0.1 %				%
	Set resolution	125mV				mV
	Input current variation *2	0.01 % of rated voltage				%
	Temperature coefficient	Rated voltage ± 100 (standard value)				PPM/°C

*1: The value is based on the temperature $23\pm 5^{\circ}\text{C}$ (with the load terminal subject to remote sensing).

*2: The value is based on the rated current variation from 10 % to 100 % at the input voltage 5 V (with the load terminal subject to remote sensing).

Table 7.1-4

		PLZ153WH	PLZ303WH	PLZ603WH	PLZ1003WH	Unit
Constant power mode (CP mode)	Operating range	15 – 150	30 – 300	60 – 600	100 – 1000	W
	Set accuracy *1	Rated power ± 2 %				%
	Set resolution	0.025 % of rated power				%
	Input current variation *2	2 % of rated voltage				%
	Ripple *3	As specified in graph 2 (standard value)				-
	Temperature coefficient	Rated power ± 1000 (standard value)				PPM/°C

*1: The value is based on the input voltage 20 V at $23\pm 5^{\circ}\text{C}$ (with the load terminal subject to remote sensing).

*2: The value is based on the input voltage variation from 20 V to 500 V at the rated power (with the load terminal subject to remote sensing).

*3: The value is based on the input voltage ripple noise less than 5 mV.

Table 7.1-5

		PLZ153WH	PLZ303WH	PLZ603WH	PLZ1003WH	Unit
Ammeter	No. of digits available	7.500	15.00	30.00	50.00	A
	Accuracy *1	$\pm(0.25\%$ of FS + 2digit)	$\pm(0.25\%$ of FS + 1digit)			—
	Temperature coefficient	± 100 of FS (standard value)				PPM/°C
Voltmeter	No. of digits available	500.0				V
	Accuracy *1	$\pm(0.2\%$ of FS + 2digit)				—
	Temperature coefficient	± 100 of FS (standard value)				PPM/°C
Power meter	No. of digits available	150.0	300.0	600.0	1000	W
		The product of current and voltage is indicated. $\pm 8\%$ of FS				—

*1: The value is based on a temperature of $23\pm 5^{\circ}\text{C}$.

Table 7.1-6

		PLZ153WH	PLZ303WH	PLZ603WH	PLZ1003WH	Unit
TrTf setting *1	Operating mode	Constant current				μs
	Set range	50, 100, 200, 500				
	Set accuracy *2	1, 2, 5, 10				ms
Switching operation	Operating mode	Constant current, constant resistance				–
	Set time range	1 – 5000				ms
	Set time accuracy	Set value ±5 %				%
Soft start *1	Operating mode	Constant current (CC)				–
	Set range	0.5, 1, 2, 5, 10, 20, 50, 100				ms
	Set accuracy	Set value ±30 %, ±100 μs				–
Remote sensing Sensing voltage *3		5				V
Protective function	Overcurrent protection (OCP)	The limiter is activated when the current exceeds the rated value by about 5 %.				
	Overheat protection (OHP)	The load current is cut when the heat sink temperature is about 105°C.				
	Reverse connection protection	The system is protected by diode and fuse.				
	Power transistor protection	The system is protected by fuse.				
	Overvoltage protection (OVP)	The load switch is turned off.				

*1: The value is based on an input voltage from 12 V to 500 V.

The rise time (Tr) and fall time (Tf) represent the time it takes the current waveform to rise from 10 % to 90 % and fall from 90 % to 10 %, respectively.

*2: The TrTf setting is valid when the load current variation ranges from 2 % to 1000 % of the rated value.

*3: 2.5 V on each side

Table 7.1-7

(Subpanel)

		PLZ153WH	PLZ303WH	PLZ603WH	PLZ1003WH	Unit
Current monitor terminal		1 V output at rated current				–
Remote control connector		8P mini connector (RC11 and RC02-PLZ can be connected)				
Trigger signal output terminal	Output resistance	10kΩ				
	Output voltage	3.5V				
	Pulse width	Approx. 10 μs				

Table 7.1-8

(Rear panel)

		PLZ153WH	PLZ303WH	PLZ603WH	PLZ1003WH	Unit	
I/O slot		Any one of IB11, RS11, and MC11S can be inserted.				-	
External control connector	CC/CR voltage control terminal *1	0 A at 0 V, rated current at 10 V (CC mode) Maximum resistance at 0 V, minimum resistance at 10 V (CR mode)				-	
	CC/CR resistance control terminal	Rated current at about 0 Ω, 0 A at about 10 kΩ (CC mode) Minimum resistance at about 0 Ω, maximum resistance at about 10 kΩ (CR mode)				-	
	CP voltage control terminal	Rated power at about 10 V				-	
	Load on/off monitor output terminal (floating output)	Photocoupler (open collector) Rated voltage: 30 V Rated current: 5 mA				-	
	Load on/off signal input terminal	Comparator level: Approx. 7 V 3.3 kΩ is pulled up at 15 V.				-	
	Range select signal input terminal	CMOS level 10 kΩ is pulled up at 5 V.				-	
	Trigger signal output terminal (floating output)	Output resistance	10MΩ				
		Output voltage	3.5V				
		Pulse width	Approx. 10 μs				
	Trigger input terminal	CMOS level, Pulled down at 100 kΩ.				-	
Current monitor terminal (current SUM output)	Rated current/1 V				-		
Short signal output	Relay contact output (25 VDC, 0.5 A)				-		

*1: Full scale and offset are adjustable.

Table 7.1-9

		PLZ153WH	PLZ303WH	PLZ603WH	PLZ1003WH	Unit															
AC input	AC input voltage range	<table border="1" style="border-style: dashed; border-collapse: collapse; margin: auto;"> <thead> <tr> <th></th> <th>Range</th> <th>Center voltage</th> </tr> </thead> <tbody> <tr> <td>①</td> <td>90 to 110</td> <td>100</td> </tr> <tr> <td>②</td> <td>108 to 132</td> <td>120</td> </tr> <tr> <td>③</td> <td>180 to 220</td> <td>200</td> </tr> <tr> <td>④</td> <td>216 to 250</td> <td>240</td> </tr> </tbody> </table> <p style="text-align: center;">The range is selectable among ①, ②, ③, and ④.</p>					Range	Center voltage	①	90 to 110	100	②	108 to 132	120	③	180 to 220	200	④	216 to 250	240	V
		Range	Center voltage																		
	①	90 to 110	100																		
	②	108 to 132	120																		
③	180 to 220	200																			
④	216 to 250	240																			
Frequency	50 / 60Hz				-																
Power consumption (GPIB board is mounted)	Approx. 50 (60)	Approx. 50 (50)	Approx. 65 (75)	Approx. 80 (90)	VA																
Rush current	Approx. 18	Approx. 22	Approx. 28	Approx. 32	A																
Withstand voltage	Primary - load terminal	1500 VAC, 1 minute				-															
	Primary - chassis	1500 VAC, 1 minute				-															
	Load terminal - chassis	500 VDC, 1 minute				-															
Insulation resistance	Primary - load terminal	30 MΩ, min., at 1000 VDC				-															
	Primary - chassis	30 MΩ, min., at 1000 VDC				-															
	Load terminal - chassis	20 MΩ, min., at 1000 VDC				-															
Operating temperature range	0 to 40				°C																
Operating humidity range	30 to 80 (no condensation permitted)				%RH																
Storage temperature range	-20 to 70				°C																
Storage humidity range	30 to 80 (no condensation permitted)				%RH																

Table 7.1-10

	PLZ153WH	PLZ303WH	PLZ603WH	PLZ1003WH	Unit
EMC	Complied with the following standards *1 IEC61326-1:1997-03 / A1:1998-05 Electrical Equipment for Measurement, Control and Laboratory Use - EMC requirements Radiated Emissions Class A Conducted Emissions Class A IEC61000-4-2:1995-01 / A1:1998-01 Electrostatic discharge IEC61000-4-3:1995-02 Radiated, radio-frequency, electromagnetic field IEC61000-4-4:1995-01 Electrical fast transient/Burst IEC61000-4-5:1995-02 Surge IEC61000-4-6:1996-04 Conducted disturbances IEC61000-4-11:1994-06 Voltage dips, short interruptions and voltage variations				
SAFETY	Complied with the following standards *1 European Community Requirements (73/23/EEC)				

*1: CE marking are put only on the products sold in Europe.

Graph 1

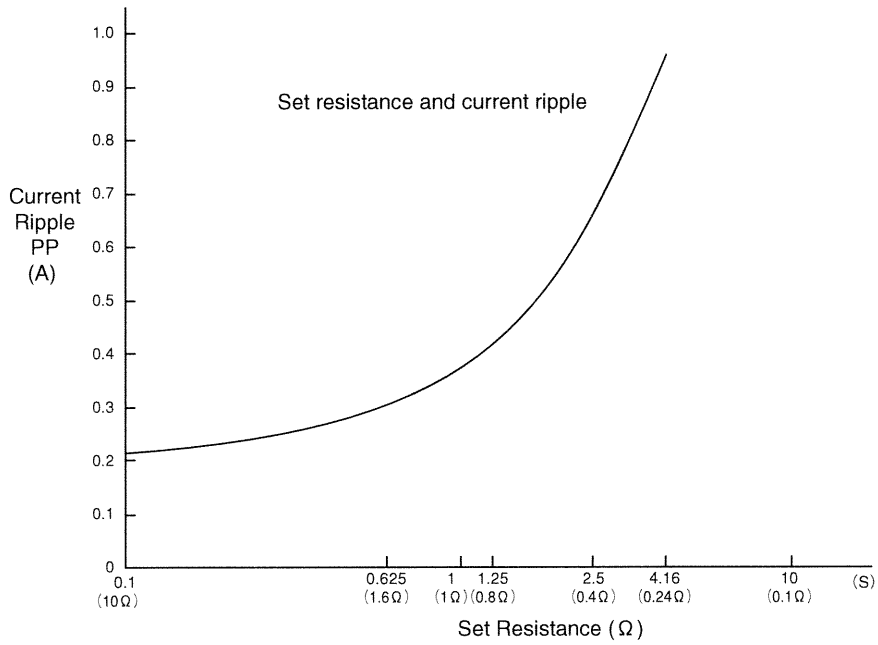


Fig. 7.1-1

Graph 2

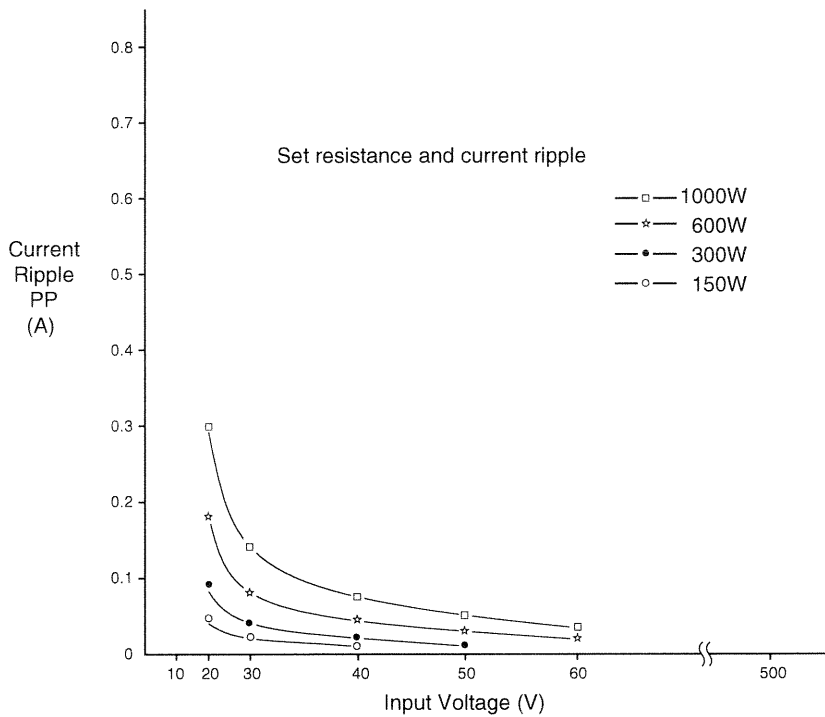
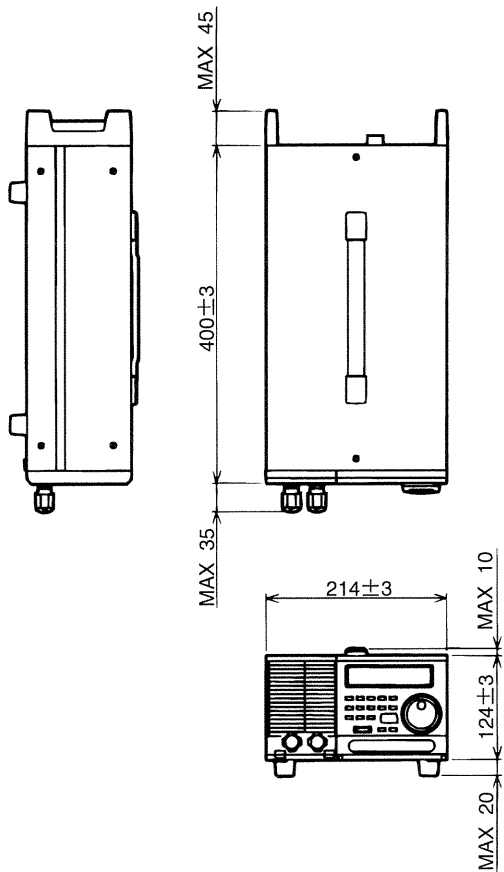


Fig. 7.1-2

7.2 Dimensions and Weight

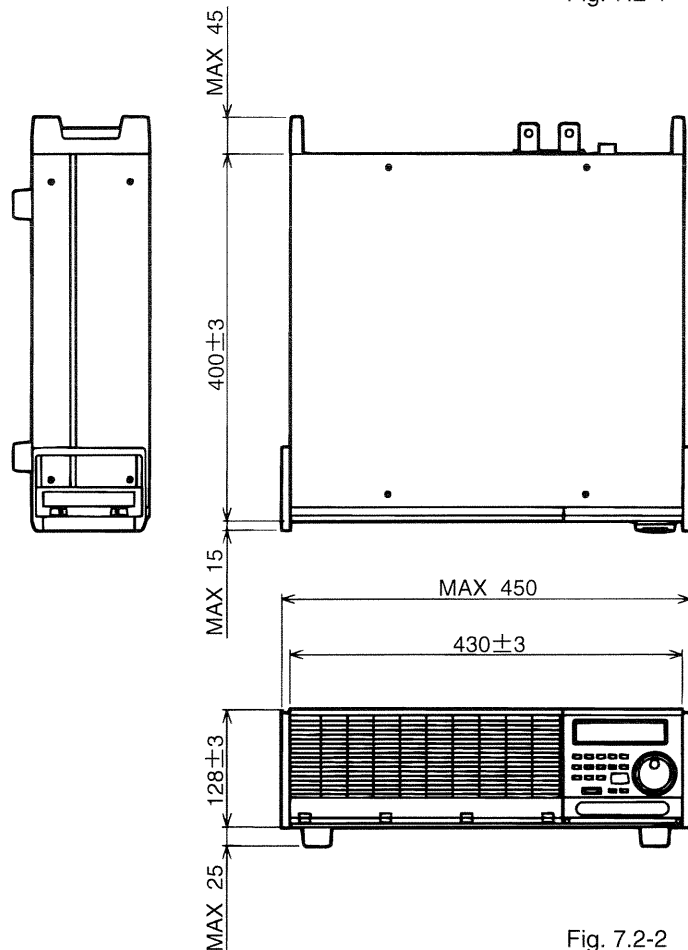


PLZ153WH: Approx. 8.5 kg

PLZ303WH: Approx. 10 kg

Unit: mm

Fig. 7.2-1



PLZ603WH: Approx. 16 kg

PLZ1003WH: Approx. 19.5 kg

Unit: mm

Fig. 7.2-2

7.3 Accessories

Table 7.3-1

Item	Quantity	Remarks
① AC power cable	1	
② Operation Manual	1	
Sequence Operation Guide Book	1	
③ External control plug	2	
④ External control plug cover	4	
⑤ Remote sensing wire kit	1	
⑥ Load terminal connecting bolt, nut, and spring washer		
M6-14	2	For PLZ153WH or PLZ303WH
M8-18	2	For PLZ603WH or PLZ1003WH
⑦ Fuse in different rating	2	See Table 7.3-2.
⑧ Seal		
Filter Cleaning seal (Japanese)	1	
Filter Cleaning seal (English)	1	
Caution seal	1	
⑨ Load terminal cover	1	
⑩ Load terminal cover securing binder	4	

The following fuses are included in the package.

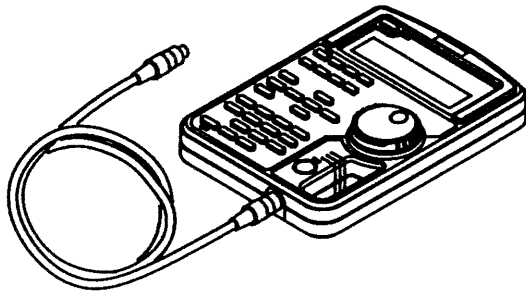
Table 7.3-2

Rated voltage: 250 VAC

	Product for 100 V power system		Product for 200 V power system	
	Fuse in AC inlet 100 V rating	Fuse, 200 V rating	Fuse in AC inlet, 200 V rating	Fuse, 100 V rating
PLZ153WH	1.5A (S.B) 1 ea.	1A (T) 2 ea.	1A (T) 1 ea.	1.5A (S.B) 2 ea.
PLZ303WH	1.5A (S.B) 1 ea.	1A (T) 2 ea.	1A (T) 1 ea.	1.5A (S.B) 2 ea.
PLZ603WH	2A (S.B) 1 ea.	1.6A (T) 2 ea.	1.6A (T) 1 ea.	2A (S.B) 2 ea.
PLZ1003WH	3A (S.B) 1 ea.	1.6A (T) 2 ea.	1.6A (T) 1 ea.	3A (S.B) 2 ea.

7.4 Options

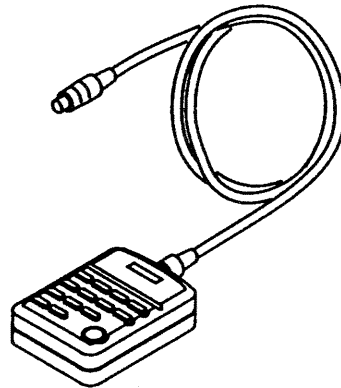
■ Dedicated remote controller



RC02-PLZ

(You can control all panel functions and enter set values from the numeric-key unit.)

Fig. 7.4-1

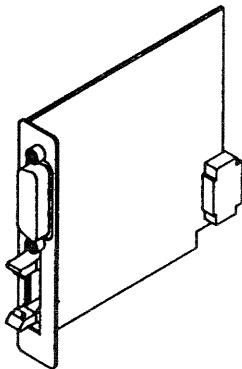


RC11

(You can enter set values from the numeric-key unit.)

Fig. 7.4-2

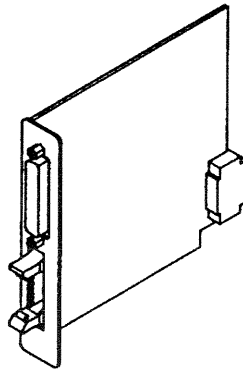
■ Interface board



IB11

(GPIB)

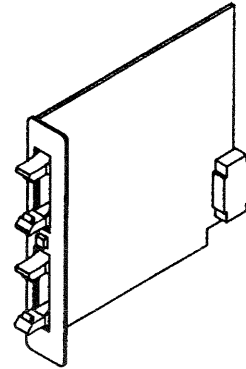
Fig. 7.4-3



RS11

(RS-232C)

Fig. 7.4-4



MC11S

(MCB: multichannel bus)

Fig. 7.4-5

■ Rack mount frame (for PLZ153WH or PLZ303WH)

KRA3 (for EIA rack)

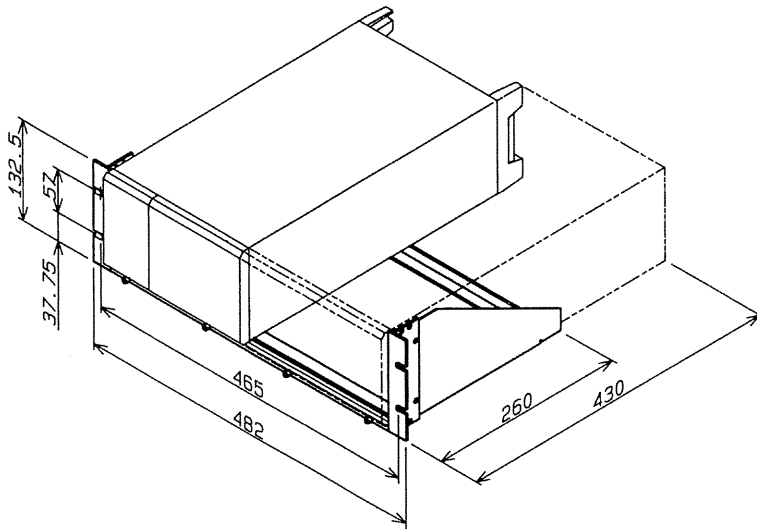


Fig. 7.4-6

Unit: mm

KRA150 (for JIS rack)

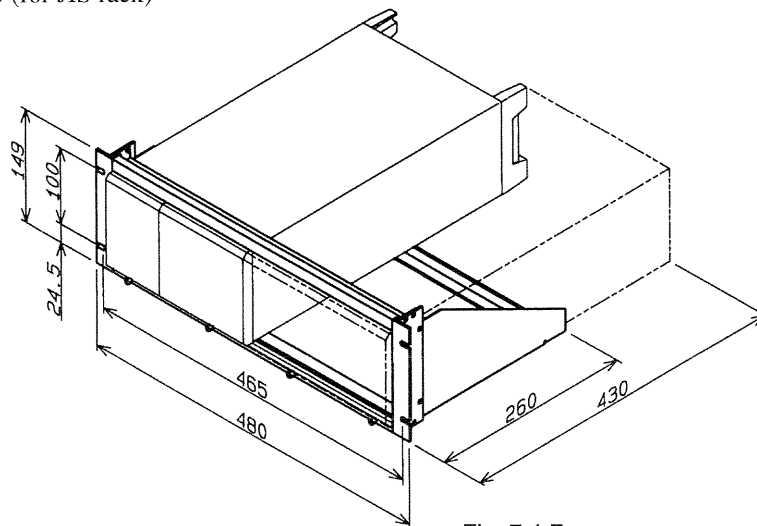
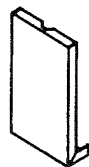


Fig. 7.4-7

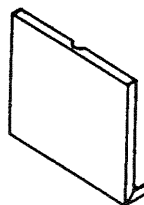
Unit: mm

Blank panel (for KRA3 and KRA150)



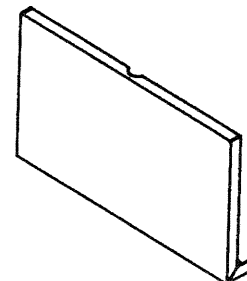
KBP3-6 (1/6 width)

Fig. 7.4-8



KBP3-3 (1/3 width)

Fig. 7.4-9



KBP3-2 (1/2 width)

Fig. 7.4-10

■ Rack mount frame (for PLZ603WH or PLZ1003WH)

KRB3 (for EIA rack)

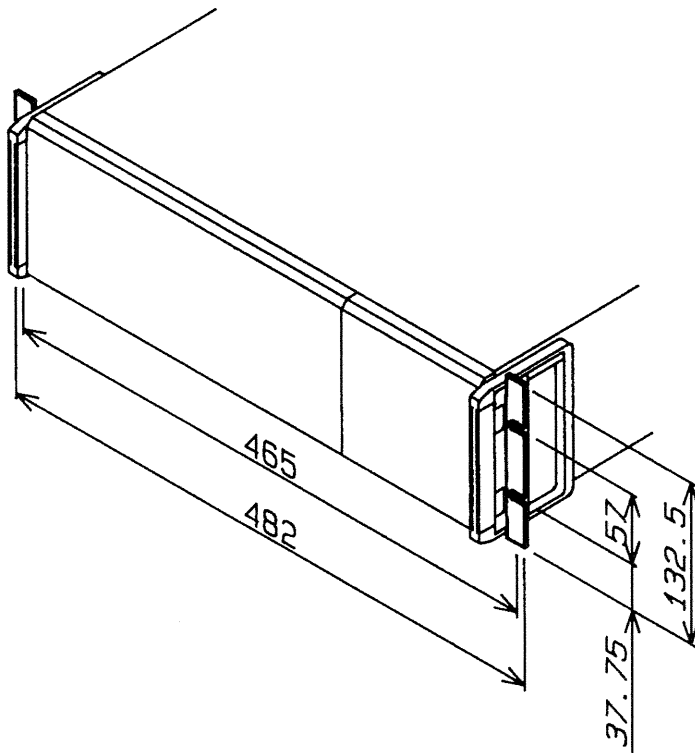


Fig. 7.4-11

Unit: mm

KRB150 (for JIS rack)

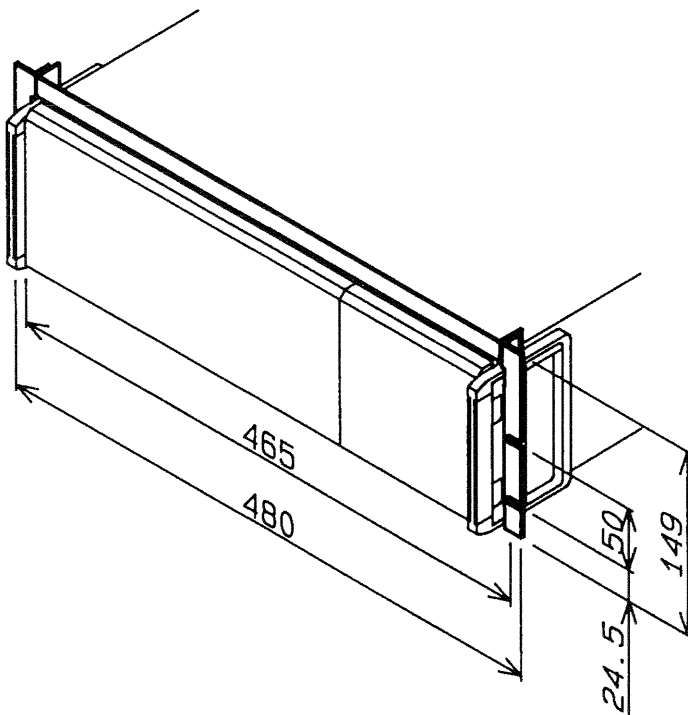


Fig. 7.4-12

Unit: mm

Appendix

These appendices list error messages, sequence preparation sheets, functions, and sample programs for the PLZ-3WH series load units.

Appendix 1 Error Message List	A-2
Appendix 2 Sequence Coding Format	A-5
Appendix 3 Function List	A-8
Appendix 4 Sample Program	A-9

Appendix 1 Error Message List

Error message	Cause and Remedy
Alarm Status	A command has been input while an alarm is in effect. Remove the cause of alarm and re-enter the command.
Argument Err	The argument of the command line is faulty. Check if a “,” is missing or the set operating range is faulty.
Change To CC Mode	The sequence operating mode does not agree with the mode set on the panel. Select CR mode using the [ISET] key.
Change To CR Mode	The sequence operating mode does not agree with the mode set on the panel. Select CC mode using the [RSET] key.
Data Clip	The value set for the sequence data exceeds the rating of your load unit. Take note that the data will be clipped. Check if the range is set to L.
Diff. Mode	The basic operating mode setting is not suitable for the command. Select a proper mode with the CCCR command.
EXECUTE 0	The sequence cannot be executed. To implement the sequence, execute the EXECUTE 1 command first.
Framing Error	A framing error has occurred in RS-232C communication. Check the baud rate and other parameters, since imperfect bits are present.
Invalidity	An invalid command has been input. Check the current settings.
Loop: 0	The number of program loops is set to 0. Reset it to at least 1.

Error message	Cause and Remedy
Memory Full	The memory size is insufficient to write the sequence program steps. (This error occurs when the number of steps exceeds 256 or 1024.)
Parity Error	A parity error has occurred in RS-232C communication. Check the communication settings.
RAM Data Error	The backup memory data has been destroyed due to use of all built-in battery power, or the RAM data has been destroyed. Keep the load unit turned on for a while, until the data returns to defaults.
RX Overflow	An overflow has occurred on the reception buffer during RS-232C communication. Check the communication settings.
SEQ Status	An invalid command has been input during a sequence operation or pause. Forcibly terminate the execution, if necessary, and enter a proper command.
SHORT Status	An invalid command has been input during a short operation. Cancel the operation, if necessary, and enter a proper command.
SLAVE Status	An invalid command has been sent during a slave operation. Cancel the operation.
Step None	An attempt has been made to delete the sequence program steps beyond the range.
Step: 0	The sequence program step area is not secured. Select "2: Insert" from the submenu of the Edit Menu and secure the area.
Syntax Error	The command input has a syntax error.

Error message	Cause and Remedy
SW Status	An invalid command has been input during a switching operation. Cancel the operation, if necessary, and enter a proper command.
TX Overflow	An overflow has occurred on the transmission buffer during RS-232C communication. Check the communication settings.
Warning Data	The value set to the sequence data exceeds the rating of your load unit. Take note that the data will be clipped. Check if the range is set to L, if the step area is not secured, or if the number of loops is 0.
ALARM EXT	An alarm signal has been input from the external connectors.
ALARM FB 3	The internal fuse is blown. Abort the load unit operation and order repair.
ALARM OCP	The load current supplied exceeds the allowable limit. Check the operating mode and reduce the load current below the limit.
ALARM MCB	An alarm for another unit of equipment has been forwarded from the MCB bus.
ALARM OHP	The heat sink temperature exceeds the allowable limit. Check if the dust filter is clogged to prevent air intake.
ALARM OVER-V	The voltage applied to the load terminal exceeds the rating. Immediately decrease the load voltage, otherwise the elements inside the load unit will be damaged.
ALARM REVERSE	A reverse voltage is applied to the load terminal.

CAUTION

- Shaded error messages relate to remote programming. However, “MemoryFull” messages apply to operations from the panel as well. If an error occurs with respect to remote programming, an error message appears for about 1.5 seconds while a buzzer sounds.
- If the same message reappears even after the cause is removed, order repair.

■ Example of coding

Coding sheet (for normal-speed sequence)

Title: Example Date: _____ Name: _____

Mode : NI, NR, NV, NP Description: _____

Time unit: msec, sec, minute, hour

Sequence

No.	Execute Program	Loop	Chain Sequence	End Program	Comments
S01	P 1	L 1	C 2	E 16	
S02	P 2	L 2	C 3	E 16	
S03	P 3	L 1	C 0	E 16	
S04	P	L	C	E	
S05	P	L	C	E	
S06	P	L	C	E	
S07	P	L	C	E	
S08	P	L	C	E	

Program No. - - -

Step No.	S/R	Specified Value	Time	Trig	Load	Pause	Short	Comments
1	S	0.50A	50ms	0	0	0	0	-Program 1
1	R	10.00A	10ms	1	1	0	0	-Program 2
2	S	10.00A	20ms	0	1	0	0	
3	S	20.00A	30ms	0	1	0	0	
4	S	0.50A	40ms	0	1	0	0	
1	S	5.00A	30ms	0	1	0	0	-Program 2
2	S	15.00A	8000ms	0	1	0	0	
3	S	0.50A	50ms	0	1	0	0	
1	S	0.50A	1ms	0	0	0	0	-Program 16

Appendix 3 Function List

	Function	Operating mode			
		CC	CR	CV	CP
1 Functions from operation panel	Control from operation panel			○	
	Load on/off			○	
	Switching	○	○	---	---
	Soft start	○	---	---	---
	Memory			○	
	Setup			○	
	Short			○	
	Normal-speed sequence			○	
	Fast-speed sequence	○	○	---	---
	Configuration setup			○	
2 External control functions	External voltage control	○	○	---	○
	External resistance control	○	○	---	---
	Load on/off			○	
	Range select	○	○	---	---
	Trigger signal output			○	
	Current monitor output			○	
	Short signal output			○	
	Load on/off signal output			○	
3 Display functions	Voltage			○	
	Current			○	
	Power			○	
	Mode			○	
	Alarm			○	
	GPIB status			○	
4 Others	Protective functions			○	
	Parallel operation			○	
	Automatic fan speed control			○	
	Remote sensing			○	
5. Option-based additional functions	Computer control (any of the following types)				
	• GPIB control (using IB11) • RS-232C control (using RS11) • MCB control (using MC11S)			○	
	Full remote control of panel-based operations (using RC02-PLZ)			○	
	Data entry from ten-key unit (RC11 or RC02-PLZ)			○	

Appendix 4 Sample Program

Sample program 1

This program reads device-model and command-error information from the load unit using GPIB, and indicates this data on the display. To allow a simpler explanation of the program, only an error-handling process for the GPIB and for the commands is listed below.

```
' Sample 1
'<<Get device model and command error information>>
'<Open GPIB device>
  Call ibfind("DEV1", bd)           'Opens the device and get a unit descriptor.
  If ibsta < 0 Then                 'Checks GPIB error at ibfind.
    MsgBox "GPIB: ibfind error!"    'Outputs an error message.
    Exit Sub                        'Exits the program without executing subsequent steps.
  End If                            'Ends the error If statement.

'<Set response header>
  Call ibwrt(bd, "HEAD 0")         'Sets subsequent response headers invalid.
  If ibsta < 0 Then
    MsgBox "GPIB: ibwrt error!"
    Exit Sub
  End If

'<Get device model information>
  Call ibwrt(bd, "IDN?")           'Sends a "get device model information" command.
  If ibsta < 0 Then
    MsgBox "GPIB: ibwrt error!"
    Exit Sub
  End If
  Dim sModelName As String         'Declares sModelName, a variable for read-out character string.
  sModelName = Space(128)         'Secures the sModelName area (up to 128 bytes).
  Call ibrd(bd, sModelName)       'Reads the device model information and saves it to the variable.
  If ibsta < 0 Then
    MsgBox "GPIB: ibrd error!"
    Exit Sub
  End If
  MsgBox Left$(sModelName, ibcntl) 'Displays the device model information read.

'<Get error information>
  Call ibwrt(bd, "ERR?")          'Sends a "get error information" command.
  If ibsta < 0 Then
    MsgBox "GPIB: ibwrt error!"
    Exit Sub
  End If
  Dim sErrorRegister As String    'Declares sErrorRegister, a variable for read-out character string.
  sErrorRegister = Space(128)    'Secures the sErrorRegister area (up to 128 bytes).
```

```

Call ibrd(bd, sErrorRegister)           'Reads the error information and saves it to the variable.
If ibsta < 0 Then
    MsgBox "GPIB: ibrd error!"
    Exit Sub
End If
Dim iErrorValue As Integer             'Declares iErrorValue, an integer variable for conversion.
iErrorValue = Val(Left$(sErrorRegister, ibcntl)) 'Converts the error information from character string to
                                                numerical values.
MsgBox "ERR Register = " & Str$(iErrorValue) 'Displays the error information read.

If iErrorValue <> 0 Then
    MsgBox "PLZ-3WH: Occur an error!"    'Outputs an error message.
    Exit Sub
End If

```

Sample program 2

This program reads device-model and command-error information from the load unit using RS-232C, and indicates this data on the display. To allow a simpler explanation of the program, only an error-handling process for the RS-232C and for the commands is listed below.

```

' Sample 2
'<<Get device model and command error information>>
'<Declare variable for RS-232C device>
Dim hFile As Integer           'File handle variable
Dim rs As Integer              'Return value from the device

'<Open RS-232C device COM2:>
hFile = rsinit(2, 9600, NOPARITY, 8, ONESTOPBIT, False, 10000)
If hFile < 0 Then               'Checks an RS-232C error.
    MsgBox "RS-232C: rsinit error!" 'Outputs an error message.
    Exit Sub                    'Exits the program without executing subsequent steps.
End If                          'Ends the error If statement.

'<Set response header>
rs = rswrts(hFile, "HEAD 0")   'Sets subsequent response headers invalid.
If rs < 0 Then
    MsgBox "RS-232C: rswrts error!"
    Exit Sub
End If

'<Get device model information>
rs = rswrts(hFile, "IDN?")     'Sends a "get device model information" command.
If rs < 0 Then
    MsgBox "RS-232C: rswrts error!"
    Exit Sub
End If
Dim sModelName As String       'Declares sModelName, a variable for a read-out character string.

```

```

sModelName = Space(128)           'Secures the sModelName area (up to 128 bytes).
rs = rsrds(hFile, sModelName, 128) 'Reads the device model information and saves it to the variable.
If rs < 0 Then
    MsgBox "RS-232C: rsrds error!"
    Exit Sub
End If
MsgBox Left(sModelName, InStr(sModelName, Chr$(13))) 'Displays the device model information read.

'<<Get error information>>
rs = rswrts(hFile, "ERR?")        'Sends a "get error information" command.
If rs < 0 Then
    MsgBox "RS-232C: rsrds error!"
    Exit Sub
End If
Dim sErrorRegister As String      'Declares sErrorRegister, a variable for read-out character string.
sErrorRegister = Space(128)      'Secures the sErrorRegister area (up to 256 bytes).
rs = rsrds(hFile, sErrorRegister, 128) 'Reads the error information and saves it to the variable.
If rs < 0 Then
    MsgBox "RS-232C: rsrds error!"
    Exit Sub
End If
Dim iErrorValue As Integer        'Declares iErrorValue, an integer variable for conversion.
iErrorValue = Val(sErrorRegister) 'Converts the error information from character string to numerical values.
MsgBox "ERR Register = " & iErrorValue 'Displays the error information read.

If iErrorValue <> 0 Then          'Checks the error.
    MsgBox "PLZ-3WH: Occur an error!" 'Outputs an error message.
End If

'<Close RS-232C device>
rs = rsdone(hFile)               'Be sure to close the device after the program execution is complete.

```

Sample program 3

This program first changes the current of the DC power supply connected to the load unit (CV operating mode), and then changes the voltage (CC operating mode). The GPIB-based sample program is described by following these steps, but the open and error-handling processes of the GPIB device are omitted below.

```

' Sample3
'<<Connect 25 V, 6 A power supply to PLZ-3WH and run PLZ-3WH in CC and CV modes>>
'<Set power to 150 W and constant current mode range to H>
Call ibwrt(bd, "HEAD 0")          'Sets subsequent response headers invalid.
Call ibwrt(bd, "PSET 150")       'Sets the power to 150 W.
Call ibwrt(bd, "CCRANGE 1")     'Sets the constant current mode range to H.
MsgBox ("Set Power Supply 25V/6A.") 'Sets the connected power supply to 25 V and 6 A.

```

```

'<Run PLZ-3WH in CC mode>
Call ibwrt(bd, "CV OFF") 'Cancels the constant voltage mode.
Call ibwrt(bd, "ISET 0") 'Sets the current to 0 A.
Dim sCurrent As String 'Declares sCurrent, a variable for read-out character string.
Dim fCurrent As Single 'Declares fCurrent, a real-number variable for conversion.
Dim sVoltage As String 'Declares sVoltage, a variable for read-out character string.
Dim fVoltage As Single 'Declares fVoltage, a real-number variable for conversion.
Dim iSetCurrent As Integer 'Declares iSetCurrent, a current setup variable.
Call ibwrt(bd, "LOAD ON@@") 'Turns on the load (hold off).
For iSetCurrent = 1 To 5
    Call ibwrt(bd, "ISET " & Str$(iSetCurrent)) 'Changes the current.
    WaitTimer (.5) 'Delay time until the measurements are determined (500 ms)
    Call ibwrt(bd, "CURR?")
    sCurrent = Space(128) 'Secures the sCurrent area (up to 128 bytes).
    Call ibrd(bd, sCurrent) 'Reads the current and saves it to the variable.
    fCurrent = Val(Left$(sCurrent, ibcntl)) 'Converts the measured current from character string to numerical
    value.

    Call ibwrt(bd, "VOLT?")
    sVoltage = Space(128) 'Secures the sVoltage area (up to 128 bytes).
    Call ibrd(bd, sVoltage) 'Reads the voltage and saves it to the variable.
    fVoltage = Val(Left$(sVoltage, ibcntl)) 'Converts the measured voltage from character string to numerical
    value.

    MsgBox "Current:" & Str$(fCurrent) & "A, " & "Voltage:" & Str$(fVoltage) & "V"
    'Displays the measurements.

Next iSetCurrent

'<Run PLZ-3WH in CV mode>
Call ibwrt(bd, "CV ON") 'Sets the constant voltage mode.
Call ibwrt(bd, "VSET 23") 'Sets the constant voltage to 23 V.
Dim iSetVoltage As Integer 'Declares iSetVoltage, a voltage setup variable.
Call ibwrt(bd, "ISET 7.5") 'Sets the current to 7.5 A.
For iSetVoltage = 15 To 10 Step -1
    Call ibwrt(bd, "VSET " & Str$(iSetVoltage)) 'Changes the voltage.
    WaitTimer (.5) 'Delay time until the measurements are determined (500 ms)
    Call ibwrt(bd, "CURR?")
    sCurrent = Space(128) 'Secures the sCurrent area (up to 128 bytes).
    Call ibrd(bd, sCurrent) 'Reads the current and saves it to the variable.
    fCurrent = Val(Left$(sCurrent, ibcntl)) 'Converts the measured current from character string to numerical
    value.

    Call ibwrt(bd, "VOLT?")
    sVoltage = Space(128) 'Secures the sVoltage area (up to 128 bytes).
    Call ibrd(bd, sVoltage) 'Reads the voltage and saves it to the variable.
    fVoltage = Val(Left$(sVoltage, ibcntl)) 'Converts the measured voltage from character string to numerical
    value.

    MsgBox "Voltage:" & Str$(fVoltage) & "V, " & "Current:" & Str$(fCurrent) & "A"
    'Displays the measurements.

Next iSetVoltage
Call ibwrt(bd, "LOAD OFF@@") 'Turns off the load (hold off).

```

Sample program 4

This program sets the current and time to the memory, and operates the load unit in switching mode.

```
'Sample4
'<<Run load unit in switching mode>>
'<Set current to memory>
  Call ibwrt(bd, "ISETAMEM 1.5")      'Loads 1.5 A to the memory A.
  Call ibwrt(bd, "ISETBMEM 2.8")     'Loads 2.8 A to the memory B.
  Call ibwrt(bd, "ISETCMEM 3.2")     'Loads 3.2 A to the memory C.
'<Set time to memory>
  Call ibwrt(bd, "ITIMEAMEM 1.0")    'Loads 1.0 s to the memory A.
  Call ibwrt(bd, "ITIMEBMEM 2.0")    'Loads 2.0 s to the memory B.
  Call ibwrt(bd, "ITIMECMEM 3.0")    'Loads 3.0 s to the memory C.
,
  MsgBox ("Start SW Operation")
  Call ibwrt(bd, "SW ON;LOAD ON")     'Turns on the load.
,
  MsgBox ("Stop SW Operation")
  Call ibwrt(bd, "LOAD OFF;SW OFF")  'Turns off the load.
```

Sample program 5

This program combines three sequences in the sec range of the NI mode, in order to run the current and time sequentially. Also, "Program 2" is repeated five times.

```
'Sample5
'<<Execute sequence operation>>
'<Set sequence mode>
  Call ibwrt(bd, "HEAD 0")           'Sets subsequent response headers invalid.
  Call ibwrt(bd, "EXECUTE OFF")      'Cancels the execute mode.
  Call ibwrt(bd, "NEWSEQ 2,2")       'Sets the sequence mode to NI-s.
'<Set sequence>
  Call ibwrt(bd, "SEQUENCE 1,1,1,2,16") 'Sets sequence number 1.
  Call ibwrt(bd, "SEQUENCE 2,2,3,3,16") 'Sets sequence number 2.
  Call ibwrt(bd, "SEQUENCE 3,3,1,0,16") 'Sets sequence number 3.
'<Write data to program>
  Call ibwrt(bd, "PROGRAM 1")        'Specifies program number 1.
  Call ibwrt(bd, "STEP 1,0,0,0,1,0,0,0,0") 'Enters 0 A, 1 s, and LOAD OFF to step number 1.
  Call ibwrt(bd, "EOS")              'Exits data write to program number 1.
  Call ibwrt(bd, "PROGRAM 2")        'Specifies program number 2.
  Call ibwrt(bd, "STEP 1,1,1,0,2,1,1,1,0,0") 'Enters 1.0 A, 2.1 s, and LOAD ON to step number 1.
  Call ibwrt(bd, "STEP ,0,1.5,2.2,0,1,0,0") 'Enters 1.5 A, 2.2 s, and LOAD ON to step number 2.
  Call ibwrt(bd, "STEP ,0,1,0,2.3,0,1,0,0") 'Enters 1.0 A, 2.3 s, and LOAD ON to step number 3.
  Call ibwrt(bd, "STEP ,0,1.5,2.4,0,1,0,0") 'Enters 1.5 A, 2.4 s, and LOAD ON to step number 2.
  Call ibwrt(bd, "EOS")              'Exits data write to program number 2.
  Call ibwrt(bd, "PROGRAM 3")        'Specifies program number 3.
  Call ibwrt(bd, "STEP 1,0,2,0,3,1,0,1,0,0") 'Enters 2.0 A, 3.1 s, and LOAD ON to step number 1.
```

```

Call ibwrt(bd, "STEP ,0,2.5,3.2,0,1,0,0") 'Enters 2.5 A, 3.2 s, and LOAD ON to step number 2.
Call ibwrt(bd, "STEP ,1,0,0,0,0,0,1,0,0") 'Enters 0 A, 1.0 s, and LOAD ON to step number 3.
Call ibwrt(bd, "EOS") 'Exits data write to program number 3.
Call ibwrt(bd, "PROGRAM 16") 'Specifies program number 16.
Call ibwrt(bd, "STEP 1,0,0,0,0.001,0,0,0,0") 'Enters 0 A, 1 ms, and LOAD OFF to step number 1.
Call ibwrt(bd, "EOS") 'Exits data write to program number 16.
'<Write comments>
Call ibwrt(bd, "TEXTIDX " & Chr$(34) & "Sample" & Chr$(34)) 'FILE INDEX : "Sample"
Call ibwrt(bd, "TEXTSEQ 1," & Chr$(34) & "Start" & Chr$(34)) 'Seq1 Name : "Start"
Call ibwrt(bd, "TEXTSEQ 2," & Chr$(34) & "Main" & Chr$(34)) 'Seq2 Name : "Main"
Call ibwrt(bd, "TEXTSEQ 3," & Chr$(34) & "End" & Chr$(34)) 'Seq2 Name : "End"

'<Execute sequence>
MsgBox ("Are you ready?")
Call ibwrt(bd, "EXECUTE ON;RUN 1@@") 'Executes sequence number 1 (hold off).

Dim sRunningStatus As String 'Declares sRunningStatus, a variable for read-out character string.
Dim iSeqInfo As Integer 'Declares iSeqInfo, an integer showing the sequence running
status.

Do 'Repeats the following statements until the sequence ends.
Call ibwrt(bd, "RUNNING?") 'Sends a "get sequence running information" command.
sRunningStatus = Space(128) 'Secures the sRunningStatus area up to 128 bytes.
Call ibrd(bd, sRunningStatus) 'Reads the sequence running information and saves it to the
variable.

sRunningStatus = Left$(sRunningStatus, ibcntl)
txtBox.Text = "Running:" & sRunningStatus 'Displays the sequence running information read.
iSeqInfo = Val(sRunningStatus)

Loop Until iSeqInfo = 1 'Checks if the sequence ends.
<End of sequence>
txtBox.Text = "The end" 'Displays an end of the sequence.

```

Sample program 6

This program monitors the status register to watch for FB (fuse blow-out) and OV (overvoltage).

```

' Sample6
'<<Monitor CP (constant power operation) and OV (overvoltage) on fault register>>
'<Set power to 135 W and current mode to 5 A>
Call ibwrt(bd, "HEAD 0") 'Sets subsequent response headers invalid.
Call ibwrt(bd, "PSET 135") 'Set the power to 135 W.
Call ibwrt(bd, "ISET 5.0") 'Sets the current to 5.0 A.
'<Set and reset register>
Call ibwrt(bd, "UNMASK 1") 'Sets the unmask register FAU bit.
Call ibwrt(bd, "FUNMASK 144") 'Sets CP and OV bits of the fault unmask register.
Call ibwrt(bd, "STB?") 'Resets the status register.
Dim sStaRegister As String 'Declares sStaRegister, a variable for read-out character string.
sStaRegister = Space(128) 'Secures the sStaRegister area (up to 128 bytes).

```



```

Call ibrd(bd, sStaRegister)           'Reads dummy for reset.
Call ibwrt(bd, "FAU?")               'Resets the fault unmask register.
Dim sFauRegister As String           'Declares sFauRegister, a variable for read-out character string.
sFauRegister = Space(128)            'Secures the sFauRegister area (up to 128 bytes).
Call ibrd(bd, sFauRegister)          'Reads dummy for reset.

Call ibwrt(bd, "LOAD ON@@")          'Turns on the load (hold off).

Dim iStaReg As Integer               'Declares a variable iStaReg.
Do                                    'Monitors CP and OV.
    ,
    ,
    DoEvents
    Call ibwrt(bd, "STB?")            'Reads the status register.
    sStaRegister = Space(128)
    Call ibrd(bd, sStaRegister)
    sStaRegister = Left$(sStaRegister, ibcntl)
    txtBox.Text = "STB: " & sStaRegister 'Displays the status register read.
    iStaReg = Val(sStaRegister)
Loop While (iStaReg And 1) = 0        'Checks the status register FAU bit.
,
Call ibwrt(bd, "UNMASK 0")           'Prohibits repeated SRQ interrupt (when SRQ is used).
Call ibwrt(bd, "FAU?")               'Reads the fault unmask register.
sFauRegister = Space(128)
Call ibrd(bd, sFauRegister)
sFauRegister = Left$(sFauRegister, ibcntl)
Dim iFauReg As Integer
iFauReg = Val(sFauRegister)
Dim sStaMsg As String
If (iFauReg And 1) = 1 Then           'Checks the fault register OV bit.
    sStaMsg = "OV bit is set."
ElseIf (iFauReg And 128) = 128 Then  'Checks the fault register CP bit.
    sStaMsg = "CP bit is set."
ElseIf (iFauReg And 144) = 144 Then  'Checks the fault register CP&OV bit.
    sStaMsg = "CP and OV bits are set."
Else
    sStaMsg = "Any other bits are set."
End If
MsgBox sStaMsg
Call ibwrt(bd, "LOAD OFF@@")         'Turns off the load (hold off).

```

About sample programs

- The sample programs shown in this manual are described in such a format that you should be able to understand how to use command messages. Therefore, the actual application software must be enhanced with safeguard and checking functions for the program.
- The sample programs described are based on the following environment.

Personal computer : IBM PC/AT-compatible machine
 OS : Windows3.1/Windows95
 Language : Visual Basic3.0, Visual Basic4.0

Module (for GPIB interface):

GPIB board: : GPIB board compliant with NI-488.2 or NI-488.2M standards (manufacturer: National Instruments)
 GPIB driver (16 bit) : GPIB.DLL (manufacturer: National Instruments)
 GPIB driver (32 bit) : GPIB-32.DLL (manufacturer: National Instruments)
 Visual Basic module file (16 bit)
 : NIGOBAL.BAS, VBIB.BAS
 (manufacturer: National Instruments)
 Visual Basic module file (32 bit)
 : NIGOBAL.BAS, VBIB-32.BAS
 (manufacturer: National Instruments)

*When a GPIB board manufactured by National Instruments is used, a dedicated driver must be installed before running the software. This driver is supplied along with the GPIB board. For information on installation procedure and configuration, refer to the manual for the GPIB board.

Module (for RS-232C interface):

RS-232C port : COM1
 RS-232 driver (16 bit) : RS232.DLL (manufacturer: Kikusui Electronics)
 RS-232 driver (32 bit) : RSDRV32.DLL (manufacturer: Kikusui Electronics)
 Visual Basic module file (16 bit)
 : RSCOMM16.BAS (manufacturer: Kikusui Electronics)
 Visual Basic module file (32 bit)
 : RSCOMM32.BAS (manufacturer: Kikusui Electronics)

*Drivers for Visual C++ and Delphi are also available, as well as the Visual Basic drivers. These drivers are uploaded to the following BBS. Please download the driver desired.

Upload BBS

NIFTY-Serve: Windows communication environment forum (FWINCOM)
 "Communication tool" library #370
 CompuServe : Microsoft Basic forum (MSBASIC)
 16 bit/32 bit OCX/DLL library
 Either library is registered to RS232 Drivers For Instrumentation.
 (You can search the library using the keyword RS232.)

IBM is a registered trade mark of IBM Corporation, U.S.A.

Windows, Visual Basic, and Visual C++ are registered trade marks of Microsoft Corporation, U.S.A.

Delphi is a registered trade mark of Borland International, Inc., U.S.A.

NI-488.2 and NI-488.2M are registered trade marks of National Instrument Corporation, U.S.A.

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